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The Iberian Stelae of the Final Bronze Age and the Early Iron Age

Iconography, Technology and the Transfer of Knowledge Between the Atlantic and the Mediterranean

EDITED BY
Ralph Araque Gonzalez, Sebastián Celestino Pérez, Raquel Vilaça

CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

THE IBERIAN STELAE OF THE FINAL BRONZE AGE AND THE EARLY IRON AGE

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Madrid, 2025

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Editors

Ralph Araque Gonzalez (Garmisch-Partenkirchen [Germany], 1978) is Principal Investigator of the project "The Iberian stelae of the Final Bronze Age: Iconography, technology and the transfer of knowledge between the Atlantic and the Mediterranean", funded by the German Research Foundation (DFG project no. 446739573) at the University of Freiburg, IAW, Department of Prehistory. He has worked on archaeological sites in Austria, Corsica, Germany, Ireland, Portugal, Sardinia, Sicily, Spain, Switzerland and Venezuela. His research interests focus on the Late Bronze Age and Early Iron Age in Western and Mediterranean Europe, rock art, prehistoric figurines and sculpture, intercultural communication and contacts, the archaeology of technology and labour, social archaeology, conflict archaeology, and prehistoric contacts between Africa and Europe. He focussed on the western Iberian stelae in his dissertation, among other expressions of Bronze and Iron Age iconography, and has published various papers on the topic. He is currently investigating problems of prehistoric stone working technologies and the earliest iron metallurgy with multidisciplinary approaches, including, most importantly, experimental archaeology and material analyses. After obtaining his MA in Prehistory and Anthropology in 2007, he was awarded a PhD in 2016 with the dissertation "Intercultural Communications and Iconography in the Western Mediterranean during the Late Bronze Age and the Early Iron Age", both at the University of Freiburg (Germany). He is a member of the Africa Centre for Transregional Research (ACT).

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Much of his research has focused on the analysis of decorated stelae, and more specifically on the study of the territories where they developed. In this regard, his monograph *Estelas de guerrero y estelas diademadas. La precolonización y el origen del mundo tartésico,* published by Bellaterra in 2001. He is currently directing the project "Construyendo Tarteso. Constructive, spatial and territorial analysis of an architectural model in the middle valley of the Guadidna", funded by the National Plan I+D+i and the Regional Research Plan of Extremadura. This project includes the archaeological excavation of the Tartessian building at Casas del Turuñuelo, which he has co-directed since 2015.

Raquel Vilaça (Coimbra [Portugal], 1958) was awarded her PhD by the University of Coimbra (1995) with the thesis *Aspectos do Povoamento da Beira Interior (Centro e Sul) nos Finais da Idade do Bronze,* published in Trabalhos de Arqueologia, 9, IPPAR, Lisbon, a work which received the "Gulbenkian Prize for Archaeology" (1997). She is Full Professor in the same university. She teaches and supervises works in the Archaeology courses (BA, MA, and PhD), and she is the Director of the PhD in Archaeology. She is a member of the Institute of Archaeology, which she has also directed, and she was editor of its journal, *Conimbriga*. She is researcher of the CEAACP/FCT – Centre for Studies

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CHAPTER 1

Introduction

Ralph Araque Gonzalez, *Sebastián Celestino Pérez* and *Raquel Vilaça*

The contributions in this book are the results of research and scientific cooperation conducted within the project "*The Iberian Stelae of the Final Bronze Age: iconography, technology and the transfer of knowledge between the Atlantic and the Mediterranean*," which was funded by the German Research Foundation (DFG, project No. 446739573). The main objective of this international research project, initiated in 2021, was the study of the complex triangular relationship between culture, technology, and communication that is represented by the western Iberian stelae of the Final Bronze Age (henceforward FBA, c. 1200-800 BC) and the Early Iron Age (EIA, c. 800-550 BC). These monuments have been extensively studied with regard to their iconography, typology, geographical distribution, as well as to their socio-cultural interpretations and integration into the ancient landscape (for example, see Celestino 2001; Díaz-Guardamino 2010; Galán Domingo 1993; Harrison 2004; Ruíz-Gálvez and Galán Domingo 1991; Vilaça 2011; see Celestino in this volume for a more complete bibliography).

The innovative approach of this project, which is presented in this volume, encompassed field work as well as the scientific testing of the prevalent hypotheses on tools used for stelae making, complemented by experimental archaeology. The research team included archaeologists, archaeometallurgists, geoscientists, IT specialists, a stonemason and two blacksmiths. For the first time, this research on the western Iberian stelae combined the perspectives of practical craftsmanship with comprehensive geo-scientific and metallurgical analyses, integrated into micro- as well as macro-scale regional studies. The fruitful cooperation of many experts in the field significantly enhanced the scope of this project and in the outcome, this book contains important contributions to contextualize the ongoing research on stelae (cf. Celestino and Paniego 2021; Díaz-Guardamino 2023).

This abovementioned project culminated in the organisation of an International Workshop Conference, held in Freiburg (Germany) in October 2023. There, in addition to the progress achieved by this research, new works were presented that served to complement some aspects that could not be dealt with in the project and which have also served to enrich this monograph. Furthermore, we have been able to incorporate additional new research that is currently being carried out on the stelae into this volume.

The different chapters of this monograph present and discuss results from various fields of research, encompassing archaeology, archaeometry, experimental replications, visual culture and landscape studies, and petrological as well as geochemical analyses. Moreover, particular Iberian landscapes with (and without) stelae will be characterized and contextualized for a broader understanding of the monuments in their social and geographical settings.

The period between the FBA and the EIA was one of dynamic transitions, far-reaching technology transfer, the emergence of extensive networks between the Mediterranean and Atlantic shores, as well as between the Iberian Peninsula and the world beyond the Pyrenees, bringing about social change and the transformation of some small communities into centralized political entities. This era was full of innovations, contradictions, complex communica-

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tions, peaceful cooperation between strangers, but also comprised social tensions, resistance to innovation and centralization processes, and violent actions (Araque 2023a, b; Celestino, Rafel and Armada 2008; Aubet and Sureda 2013; Moore and Armada 2012; Ruiz-Gálvez Priego 2015). It should be noted that some authors prefer the term "Late Bronze Age" (LBA) instead of "Final Bronze Age" (FBA), referring to the exact same chronological period.

The stelae in the western Iberian Peninsula are striking expressions of these events and depict symbols that cover most of these core aspects, with artefacts and images pertaining to Atlantic and Central Europe as well as to the Mediterranean region, which incorporated the African and Asian continents into this amalgamation of knowledge and ideas. The theme of technological transfer between craftspeople is inseparable from the depiction of technologically complex objects, for example chariots, specialized bronze artefacts (i.e. sheet bronzes, helmets, mirrors, swords), musical instruments, jewellery, and dress, which is represented by fibulae. Moreover, this aspect is expressed in the choice of rocks and the various tools that were used to make stelae.

Furthermore, images of warriors and weapons might represent the conflict and threats that went along with the new connectivity and the exchange of valuable materials in haphazard journeys to distant lands and anchorages. Finally, the inclusion of mystical figures and portentous scenes, or musical instruments and communitarian dances, allows for glimpses into the spiritual, ritual, and festive world of the people behind the stelae. Nevertheless, the actual significance and meaning of these rock art monuments still evade any conclusive interpretation and leave ample space for scientific discourse.

Throughout the contributions to this book, the western Iberian stelae will be examined as multidimensional archaeological subjects. The lithic materials that were used to screen symbolic information in the form of selected objects, the necessary tools and technologies to do so, the positioning in the landscape, and the geographic distribution of the monuments are regarded as inseparable cognitive units. Even their absence in some neighbouring regions, contrasting with their concentration in others, can deliver valuable insights.

The edition of a monograph discussing the stelae and their chrono-cultural aspects, with researchers from various disciplines and with different positions, involves some problems that we have tried to solve as even-handedly as possible. Therefore, for example, we have extended the chronological framework in the title to include those who advocate a more recent chronology for the stelae, or at least for some of them, which would attribute them into the full Iron Age. It has been more difficult to find a consensus definition that identifies them geographically, given the increasing dispersion of new finds, and finally, we have chosen to refer to them as "decorated stelae from the western Iberian Peninsula". However, we are aware that the broad geographical framework discriminates against stelae from the north-east of the Peninsula and the south-east of France, but we have preferred to focus them on the geographical environment – the western half of the Peninsula – where they are mostly found. Lastly, we have chosen not to overstate the debate on typologies, as we believe that this subject has been dealt with on numerous occasions and has only provided limited advance for our knowledge of the stelae beyond their iconographic analysis. Moreover, the fact that a large number of stelae are fragmented makes it impossible to draw up a coherent and detailed sub-typology.

Finally, and as it has already been mentioned above, we believe that an important approach in order to advance our knowledge of the stelae is to explore innovative lines of research in order to discover new aspects of the material significance and application of the stelae's rock supports, their production techniques, their territorial analysis and, as a final objective, their social significance.

In Part I of this book, the western Iberian stelae are presented in the light of new research and updated with recent finds, with regards to their iconography, geographic distribution, and in their cultural as well as intercultural contexts. S. Celestino (chapter 2) introduces the research on stelae with a historical overview and in the light of the rapidly growing number of new finds as well as novel methodological and conceptual approaches.

P. Paniego (chapter 3) provides a revision of the geographical distribution of stelae, as well as of the individual and collective arrangements of the depicted objects by incorporating data from the latest findings, and finally proposes a new and simplified typological classification. He also considers their chronology and the possible relevance of diverse forms of societal organisation behind this distribution.

V. Rammelkammer (chapter 4) presents a reassessment of research on the so-called "diademada-stelae" and "ídolos-guijarros", which are often considered as female counterparts to warrior representations. She discusses the chronological approaches that often consider the smaller "ídolos" to be significantly older than the "diademada-stelae" from the FBA-EIA and presents a revision of the contexts, typology, and approaches towards these highly characteristic expressions of Iberian iconography in later prehistory.

R. Vilaça and C. Bottaini (chapter 5) investigate the problem of shields, which have not been found in their entirety in Iberia, but are most frequently represented on the stelae. Their study is based on the evaluation of dome-headed rivets that might possibly serve as tangible traces

of actual shields, and presents preliminary results from contextual, archaeological, and material analyses.

G. Pulido-González (chapter 6) analyses the distribution and meaning of the representations of those elements on the stelae which possibly depict objects that were once imported to Iberia. She highlights preferences for particular objects of Mediterranean origin between different areas and intents to detect the likely routes of the arrival of these supposed imports. Moreover, she presents hypotheses why some regions seemingly preferred representing "Atlantic" over "Mediterranean" objects and proposes chronological as well as cultural implications.

Part II presents three distinctive landscapes with stelae (the Portuguese Beira Interior, Spanish Extremadura, and the region of Toledo) as well as one relevant Iberian landscape without stelae, but very close to their epicentres (the Portuguese central Alentejo), with their distinctive geological features that strongly influenced the choices of FBA-EIA artisans. The contributions take into account the rock materials that were used, the iconographies of stelae that emerged in these areas, and their transport and positioning in the landscape with relevance to pre- and protohistoric sites, route systems, rock outcrops, and natural resources. This approach allows for a deeper understanding of the monuments in their physical and geographical settings.

R. Ferreiro Mählmann, R. Araque Gonzalez, P. Baptista, P. Paniego, and E. Merino-Martínez (chapter 7) present results from extensive petrological and geochemical studies of stelae and outcrops in the Portuguese Beira Interior and the Spanish Extremadura, with a focus on the Zújar valley. They show the selective patterns for the choices of rocks for stelae and investigate the implications of these material selections with relevance to the underlying knowledge of materials and technologies that had to be applied for rock art making in FBA-EIA Iberia.

M. Osório, P. Baptista, and R. Vilaça (chapter 8) outline the main aspects of the FBA occupation in the westernmost area of the Iberian Central System and the relationship between stelae, sites, metal ores, and the regional lithology, based on a holistic and integrative perspective. They argue that the stone monuments did not only mark specific places in their territory, but were also placed in a way to (re-) structure the cultural as well as physical landscapes.

P. Baptista, R. Araque Gonzalez, and R. Ferreiro Mählmann (chapter 9) analyse the transportation and integration of western Iberian stelae within the FBA landscape of the Portuguese Beira Interior through GIS-based spatial analyses. Visibility and accessibility analyses, petrological studies, labour estimates, and observations from fieldwork and experimental archaeology allow for the contextualization of the complex and dynamic relationship between paths, quarries, ores, and FBA communities.

J. Pereira Sieso, T. Chapa Brunet, P. Andonaegui Moreno, E. Merino Martínez, C. Gutiérrez Sáez, A. Uriarte González, P. A. Saura Ramos, P. Muñoz Moro, Á. Crespo Fraguas, and A. I. Pardo Naranjo (chapter 10) present a comprehensive study of the stelae in the Toledo region, encompassing petrological and geochemical provenance analysis, iconographic and technical studies, as well as the spatial analysis between their locations and natural fords of the Tagus river. This provides exclusively deep insights into this particular landscape during the FBA-EIA and allows for conclusions that might also affect other regions with stelae.

R. Mataloto (chapter 11) introduces the unique landscape of the central Alentejo in Portugal. He presents several sites from the FBA that indicate a complex network of decentralized, however interdependent communities. It is remarkable that there are no stelae recorded from this region, although they are frequent just on the other side of the Guadiana river, in Spanish Extremadura. However, the small metallurgist site of Rocha do Vigio, where a hardenable steel chisel from the FBA-EIA transition has been excavated, has significant relevance for the technologies that might have allowed for the making of stelae from extremely hard rocks. Mataloto also highlights curious parallels between the stelae, steel, and a famous fantasy character from modern popular culture.

The investigation of the FBA-EIA steel chisel from Rocha do Vigio, made with a most innovative material in this southwestern Iberian metallurgist hamlet in such an early period, has important ramifications for the stelae and was integrated into the archaeometallurgical branch of this research. The analytical and experimental approaches towards the making of rock art are the focus of Part III of this book.

By seizing the rare opportunity of analyzing the Rocha do Vigio steel chisel that is most probably contemporary to the FBA-EIA stelae, R. Araque Gonzalez, B. Asmus, A. Richter, G. Vintrici, and R. Ferreiro Mählmann (chapter 12) set out to investigate the toolkit of prehistoric stonemasons. The comprehensive methodology encompasses archaeometallurgical and petrological analyses of the available metallic as well as lithic tools, their replication, and their comparative experimental trial on the same hard rocks that were used for the stelae. The most striking observation is the requirement of steel tools to carve silicate quartz arenites ("quartzites") that were used for a group of stelae in the Zújar river valley.

In this context, T. Mink (chapter 13), an experienced blacksmith and one of the last very few craftspeople in Europe who masters this process, presents his techniques for making a direct reduction furnace, similar to those found in pre-industrial contexts throughout Europe and the Ibe-

rian Peninsula, and the subsequent extraction of iron and steel from the ore minerals. He became part of this research group after the connection between some stelae and iron technology became evident, and describes the challenges of obtaining hardenable steel with this method.

Archaeometallurgist and bronze caster B. Asmus (chapter 14) analyzed both, the archaeological chisel from Rocha do Vigio and the replicated chisel from the smelting experiment with T. Mink. Therefore, this book presents a blacksmith as well as an archaeometallurgist perspective on bloomery smelting. Asmus compares the metallographic data, examines the smelting variables, and provides invaluable insights into the transfer of knowledge, differences and similarities in bronze- and iron working, and possible adaption processes by FBA-EIA metallurgists. He argues that at the evidently high level of bronze working skills which prevailed in FBA Iberia, it would have been only a question of time until the properties of a new metal, iron, would be mastered.

Part IV of this book is focussing on theoretical and cognitive approaches towards rock art, thereby complementing the results from material and experimental analyses, geology and landscape analyses, and chrono-cultural archaeological evaluations. The biases of our contemporary views on ancient techniques and forms of representation are directly addressed in this section.

A. Santos (chapter 15) discusses the multiple ways in which the representations of the human body have changed with time in Iberia, beginning with Neolithic and Chalcolithic art, to Bronze Age statue-menhirs, and finally to the FBA-EIA stelae, which become, during this period, the most popular means of representing the human body. Moreover, she states that the problem with the ambiguity of representations of sexual indicators, and even their anthropomorphism, have to do more with interpretation than with analytical methodologies.

C. Huth (chapter 16) provides most important insights from cognitive studies of visual representation and pictorial art, which are unfortunately often neglected in archaeological studies. He shows that the way things are depicted on a plane surface is heavily influenced by cognitive processes which are not so much culturally determined but universal. The "fold out" images of four-wheeled chariots on the western Iberian stela, in Scandinavian or Alpine rock art, or on pottery in various European regions serve as splendid examples, showing that they might have nothing in common except for their universal pictorial appearance.

R. Udochukwu Ucheh (chapter 17) presents the only group of artefacts in this book that is not related to the decorated western Iberian stelae, neither chronologically nor geographically: he introduces the Carved Stone Balls of Scotland, mainly thought to originate from the Neolithic to the Early Bronze Age, in their cultural and environmental setting. However, these objects also represent an enigmatic assemblage of rock art, they are often made from hard materials with fine carving and manipulation techniques that are still considered astounding within the scope of current analysis, and they are rarely found within datable contexts. This shows that archaeologists working in different fields and regions face similar challenges and we need to connect our approaches in order to advance with our understandings of decontextualized artefacts that evade simplified explanatory approaches concerning their function, meaning, and making.

In summary, the book presents and discusses geo-scientific, archaeometallurgical, landscape analytical, traditional archaeological, anthropological, and experimental data. These are the "hard facts" from where future research can develop and which will hopefully be extended to a base that allows for breakthroughs in chronology, technological studies, and socio-cultural understandings. The interpretative and deductive approaches of the contributing researchers, however, are almost as varied as the involved disciplines and backgrounds. As mentioned above, it is clear that divergent opinions prevail on key issues and full agreements could not be reached (nor was this a major objective), for example on the absolute chronology as well as the social, spiritual, ideological, and other immaterial meanings of the stelae.

Some researchers would rather attribute them to the Final Bronze Age, predominantly based on the artefacts that are represented and on their embedding in chrono-cultural constructs that would make this attribution plausible (for example, Araque Gonzalez 2018, 204-237; Brandherm 2013; Díaz-Guardamino 2010; Harrison 2004). Others would rather assign the stelae to the Early Iron Age, relating them partly to the influence of eastern Mediterranean seafarers, or Phoenicians, and the emergence of a political entity known as *Tartessos* in Iberia (see Celestino 2023; Celestino and Paniego 2023; Celestino and Salgado 2011). Notably, the longstanding use of most of the depicted objects often allows for a generous interpretation in this regard. The phenomena of the reuse or transformation of supports should be discussed, particularly concerning ancient menhirs, and it is important to note that this aspect is not specifically or simply chronological, but involves the very temporality of the stelae and hence goes way beyond it (see for example Vilaça 2021). Furthermore, there are those stelae that display the addition of non-figurative elements, and therefore another (or a new) strategy in the type of message, such as Tartessian writing, often engraved with different techniques and even of opposite orientation.

However, the chronological context is crucial for the subsequent interpretation of their possible socio-cultural

meanings, due to the significant changes and centralization processes that took place from the FBA into the advancing EIA. Were the stelae the testimonials of chiefs, a form of auto-representation, or their funerary monuments, i.e. the memory of the dead, even when the body is missing? Did they hence represent chiefdom societies in a social archaeological sense, and might even hint to the deification of such chiefs? Or were, at least some of them, inspired by religious concepts and hence represented proper divinities, maybe related to the horned gods of the eastern Mediterranean or the Sardinian horned warrior bronze figurines from water sanctuaries (see also Araque 2023a)? Could they have been the symbolic expressions of small, decentralized societies, or of pastoral groups, to communicate abstract concepts or liminal spaces? Do they point to the integration of new customs and reflect the challenges that the influx of people from the Mediterranean brought about, or contrariwise, indicate resistance to them?

These and other questions cannot be answered conclusively in the continuing absence of a significant number of unequivocal primary contexts that could be excavated with state-of-the art methods, thus most of them will remain open to debate. Without a few *in situ* finds of stelae from the core areas of distribution in their primary contexts, especially their actual chronology remains a debatable matter. This research project provided a highly probable *terminus post quem* for at least those stelae made from silicate quartz-arenites and similarly hard quartzite, which is after the introduction of hardenable steel tools.

However, as if to make things more complicated, the chisel of Rocha do Vigio, which was found downstream from the Zújar confluence to the Guadiana river, is dated to 900-770 cal. BC (see Mataloto, this volume, with bibliography). Hence this insight favours neither direction, as it indeed remains just in the transition between both. Furthermore, iron has been used for small tools in Portugal since the FBA, possibly as early as the 12th-11th centuries BC (Jambon *et al.* 2023; Vilaça 2013). Eventually, this could mean either that there was an exceptionally early introduction of iron technology in western Iberia, or that many stelae are younger than it had formerly been anticipated – certainly, further research will be required.

The convergence between the involved researchers and an open, respectful debate, together with combining a variety of approaches and opinions, resulted in the chapters presented in this book. The effects of mutual learning, not only between scholars of different disciplines, bringing together senior and junior researchers, but also between them and the participating craftspeople, opened new trajectories for our future research. Debate is at the heart of any scientific progress, and it is only fuelled by differing opinions that challenge each other. As the scientific data acquisition and archaeological fieldwork advance, we hope to soon have more valid foundations for our discussion of this most significant time period of Mediterranean and European (pre-)history, of which the stelae are a most impressive expression in Iberia.

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PART I

The Iberian Stelae of the Final Bronze Age and Early Iron Age: Research, Iconography and Geography

CHAPTER 2

The General Context of Stelae

Sebastián Celestino Pérez

Abstract

The bibliography on the different aspects of the stelae from the west of the Iberian Peninsula is practically inexhaustible after more than a century of work on their significance. A review of the main investigations carried out over this long period of time allows us to ponder their complexity, but also the progress, albeit timid, that has been made in recent years thanks to the incorporation of studies of the territory where they were found, to new computer methodologies and, especially, to the incorporation of analytical studies, which has been joined more recently by work related to experimental archaeology. This paper not only aims to summarise these works, but also to provide new insights into the question of their geographical dispersion, their chronology and their possible meaning.

1. Introduction

The conceptual evolution that the stelae have undergone since the discovery of the first examples is a direct consequence of the numerous discoveries made in the last half century, where their original area of expansion, Extremadura, has been clearly surpassed; thus, they went from being called «stelae of Extremadura» to «southwestern stelae», although, after the discoveries of recent years it seems more logical to designate them as «western stelae», given that they occupy a good part of the Atlantic coast of the Iberian Peninsula. In the same way, their meaning has changed, because if originally, and still today, they are known as «warrior stelae», we cannot ignore that some of them represent a female character wearing a diadem, so we should refer to warrior and diademed stelae, undoubtedly contemporary; but there have also been documented stelae where both characters appear, which we could refer to as mixed stelae. Finally, we should also bear in mind that there are a good number of stelae with characters without weapons, which they replace with other elements of prestige. For this reason, it is difficult to choose a name that groups them all together, so the geographical term seems the most appropriate to identify the phenomenon (see Paniego, this volume, Fig. 2).

The profound change in their meaning and functionality has been even more telling. From being understood as funerary monuments marking graves, they have come to be seen as cenotaphs, but also as milestones at places of passage, or a combination of these functions. The meaning of the representations is also varied, as what some see as warriors, others see as heroic characters or, more recently, as representations of deities, something that could be extended to the images engraved on the female or diademed stelae.

Another problem on which the bibliography has been recurrent is the chronology of the stelae, based on the objects engraved on these monuments. In this aspect, the degree of discrepancy between the different authors is more profound, as there are those who consider them to be derived from the Alentejan stelae of the middle Bronze Age, to those who derive them from the Late Bronze Age, although, in my opinion, the bulk of the stelae would already be from the Tartessian period, i.e. from between the 8th and 6th centuries BC. Thus, the debates on whether the chariots and lyres are of Mycenaean origin or were introduced by the Phoenicians are still ongoing, but it is obvious that they have not served to establish a chronology that is accepted by all the researchers who have approached their study.

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Today the trend is to study the stelae from two perspectives: the territory where they were found, and the techniques with which they were made: two lines of research that are opening up a new perspective in order for us to gain a better understanding of the stelae.

2. General background

Papers on decorated stelae of warriors and women are so abundant and, on occasions, meticulous, that it would be impossible to review, even briefly, the bibliography generated in the more than one hundred and twenty years of history of this phenomenon. The discoveries have come and gone in dribs and drabs since the appearance of the first example in 1898, and in fact it was not until 1950 that the first corpus was published, which included the first set of so-called 'sepulchral slabs', in line with the bronze-age slabs from the Alentejo region (Fernández Oxea 1950). Following the discovery of a few more examples, Almagro Basch (1966) published a monograph on the decorated stelae of the southwest of the Iberian Peninsula, which included the stelae from the Alentejo and made an initial ethnic assessment of the warriors represented, placing them in the Indo-European sphere, a catch-all description that has served for years to cover any cultural manifestation prior to the Mediterranean colonisation of western Europe.

Until then, all the debate on the peninsular stelae focused on the best and most represented object: the shield, essential for tracing the maritime and land routes by which they could have reached the southwest of the Iberian Peninsula. We will now examine the most solid proposals that have enjoyed the greatest support. The first proposal was that of MacWhite (1951, 103-105), who suggested a route originating in the Aegean, reaching Central Europe and Scandinavia, and from there, via the «Atlantic route», to the southwest of the Iberian Peninsula. Hencken (1950, 305-307) also placed the origin of the shields in the Aegean, but proposed two independent circulation routes: the first, through Central Europe to Scandinavia following the amber route; and the second, through the Mediterranean towards the Iberian Peninsula as a result of colonisation. For Sprokhoff (1954, 74), however, the origin of the shields should be located in Central Europe, from where they would reach the Aegean and from there, also thanks to colonisation, to the southwest of the Iberian Peninsula.; a hypothesis endorsed years later by Schauer (1980, 238), who nevertheless proposed that the arrival on the Iberian Peninsula from Central Europe would have taken place thanks to the Urnfield culture, i.e. from the north east of the peninsula. One of the most complete and scholarly works on shields is by Coles (1962), who made an in-depth study of the specimens with a V-shaped notch, concluding that they originated in the Aegean, from where they would have spread to the rest of Europe, thus validating Hencken's thesis. In the same year, Satou (1962, 540) proposed the origin of the shields in the Scandinavian region and, the Swedish archaeologist Bo Gräslund (1967, 70-71), formulated that the shields with a «V» shaped notch would have originated in the near eastern area, specifically in the Phoenician world, providing as proof the presence of the shields with a notch in peripheral areas of Greece that were highly influenced by the Phoenician presence, such as Cyprus or Crete; Therefore, they would have arrived in the Iberian Peninsula with the Phoenician settlers, a hypothesis that was widely echoed by some Spanish historians (Blázquez 1986, 477).

Finally, in 2001, I devoted an extensive chapter to the shields on the stelae of the southwest in which I defended their origin in the Iberian Peninsula (Celestino 2001, 150-151); I based my hypothesis on the chronology of the oldest stelae documented in the Portuguese Beira and in the Tagus valley, made before the Mediterranean colonisation, as demonstrated by the absence of imported objects. Moreover, all the coats of arms found outside the Iberian Peninsula clearly postdate the 8th century BC, at least two centuries after the beginning of the stelae phenomenon, so it is difficult to find arguments against their Iberian origin, from where they would spread throughout the European Atlantic and, thanks to colonisation, throughout the Aegean, now generally in the form of ceramic votive offerings. A hypothesis that had been tentatively outlined by J. A. Barceló (1989, 153) and revalidated years later by R. J. Harrison (2004, 134). Unfortunately, the absolute dating that has been carried out on the Swedish and Irish shields has not been able to resolve the question of chronology. Although G. Eogan (1964, 322) had dated the Irish V-shaped shields to the Dowris Phase of the Late Bronze Age, around the 7th century BC, a battery of radiocarbon dates made on the casts of these shields years later suggested that the specimens could be dated to the transition between the 2nd and 1st Millennium (Hedges *et al.* 1991), but the standard deviation of these dates was too high; a few years later radiocarbon analyses were again carried out on shields from the British Isles (Needham 1996), but also with very relative results, as they were carried out on the wood of the shields, obviously prior to their manufacture, and with a very long time frame. This long chronology for the Atlantic shields has been defended by other authors (Mederos 2012), although they are based on unreliable dating, as I have already mentioned.

Since then, and after all the possibilities about its possible origin have been exhausted without a consensus among specialists, the shield has come to be addressed as just another element of the stelae, without denying its special singularity, but ceding its prominence to other

equally relevant representations that I will deal with in more detail later on.

From the 1970s onwards, and with 30 stelae documented, the first typological tests began to be carried out, all of them respecting the funerary function that Almagro Basch had given the stelae, but with profound discrepancies as to their chronology. Almagro, in his 1966 monograph, divides the stelae into two types: I. Alentejan stelae, and 2. Decorated stelae from the south-west, on which all the research would be focused. In turn, Pingel (1974) subdivides them into IIa, with only the shield, sword and spear; IIb, with foreign elements; and IIc, with a warrior. In 1977, two new typological studies appeared, the first by Gomes and Monteiro, who added to Pingel's typology the subtype IId, where secondary scenes are developed, relating these stelae to the exploitation of minerals as a consequence of Mediterranean colonisation. The second is that of Almagro Gorbea, which adds a subtype IIe whose characteristic is the absence of the shield.

The appearance in 1961 of the stela of Cuatro Casas, in Carmona (Seville), altered the geographical designation of «Extremaduran stelae» which had been recurrently used until then and which, logically, fell into disuse, especially when a few years later other Portuguese examples and the stela of Ategua, in Cordoba, appeared, which also gave rise to a bold interpretation that today seems to be established; According to its authors, the stelae depict indigenous hierarchs surrounded by elements of Mediterranean origin as a result of Phoenician colonisation (Blanco *et al.* 1969). In this sense, Bendala (1977) published an article of great repercussion in which he argued for the arrival of Greek products to the peninsula before colonisation, the so-called pre-colonisation period, to which period all the elements represented on the stelae would correspond.

In the following decade a large number of articles were published thanks to the continuous appearance of new specimens in more and more scattered parts of the peninsula, although they were limited to descriptions of the monuments and some isolated contributions on their cultural significance. In these studies, the authors generally adhered to the typologies and chronologies that had already been sketched out, generally ascribing them to the Late Bronze Age. In addition, and with a significant number of stelae documented, around 80 examples, some interesting studies emerged that claimed new trade routes that would justify the presence of some of the elements represented on the stelae, such as the swords, as a result of which the Atlantic-Mediterranean route, mainly via Sardinia, gained certain prominence (Delibes and Fernández Miranda 1984; Delibes *et al.* 1988; Ruíz-Gálvez 1986).

Barceló (1989) is critical of the two main lines of research that prevailed at the time. Although he defends the trade route between the French southeast, Sardinia and the southwest of the Iberian Peninsula, a hypothesis that years later Botto (2013, 198) defended, he believes that all the carved elements predate Phoenician colonisation. And it is precisely the elements represented on the stelae that become the focus of his central discourse, thereby distancing himself from the evolutionary typologies published up until that time.

Perhaps a little discouraged by so many disparate arguments that had led the question of stelae to a dead end, in 1990 I wrote an article in which I avoided the formal evolution of monuments and chronologies in order to focus on an issue that until then had hardly been addressed and which was closely related to the new trends that were then developing within archaeology: territorial analysis. Thus, I focused on the geographical dispersion of the stelae, where certain particularities could be appreciated depending on the different established areas: Sierra de Gata (Malcata), Tajo-Montánchez, Zújar and Guadalquivir. I divided the monuments into burial slabs and stelae for cremations, the latter from the time of the Phoenician colonisation onwards. Today I can no longer support any of these working hypotheses, which were even revised in the publication of the 2001 monograph, when 93 examples were already known. I accepted, with slight modifications, the typology of Pingel, Pinho Monteiro and Almagro-Gorbea and placed special emphasis on the geographical dispersion of the stelae; all of this has now also been superseded by the fact that previously isolated areas have been filled in, with the Beira interior taking centre stage (and this is not valid, of course, for Harrison, who reproduced the proposed geographical areas). Perhaps the most novel contribution refers to the evolution of the stelae from the Portuguese area and the Tagus towards the Guadiana and Guadalquivir valleys. Thus, the stelae would have emerged in the Late Bronze Age and would have developed towards the Guadiana in the middle of the Iron Age, coinciding with the Mediterranean colonisation and the rise of Tartessus, while their extinction would have occurred in the 6th century, coinciding with the so-called Tartessian Crisis of the core area.

Earlier, in 1993, Eduardo Galán published a monograph on stelae which aroused great interest because it also focused on the analysis of the landscape in which these monuments appeared. But he also introduced a new meaning for the specimens that was far removed from the one that had hitherto met with a certain consensus: that is, the relationship of the stelae with the funerary world, either as grave markers or as cenotaphs. Galán's new hypothesis, which does not, however, rule out the possibility that they have a funerary significance, proposes that the monuments would have served as markers for the passage of livestock and trade routes thanks to their being found in strategic

locations and next to watercourses, a hypothesis that stems from a previous study (Ruíz-Galvez and Galán 1991). Therefore, they reject the funerary significance of the stelae, something that, nevertheless, was already proposed by other authors in a contemporary work on the funerary world of the Late Bronze Age (Belén *et al.* 1991). This work has had and still has supporters and detractors, because if the areas where the stelae have appeared are, logically, strategic areas, close to water points and presumed trade routes, it is also true that the supports with which they were made would go completely unnoticed in the landscape, both because of the stone used and because of the small size of some of them. But we will talk about this later on. He considers that the stelae were created in the Tagus valley and in no case would have survived the Phoenician colonisation, which was the cause of their extinction. He bases his hypothesis on Sherrat's theory of Centre - Periphery - Margin, where the area of the stelae would be the margin of the margin.

Harrison's 2004 monograph is perhaps the least innovative, as it refers to previous typologies and chronologies (13th to 8th centuries BC) and characterises the four geographical areas already established. His contribution focuses on the definition of the warriors depicted on the stelae, interpreted as heroes with their respective attributes.

Finally, in the first decade of the 2000s, a considerable number of finds were made, 12% more (109 stelae), which led some researchers to make new contributions, some of them relevant, now oriented towards the iconographic interpretation of the stelae, emphasising their relationship with the landscape. The first outstanding work is that of Moreno Arrastio in which he attributes to the warriors on the stelae a hitherto unpublished function; for him, the stelae represent characters related to hunting and the slave trade in the context of Phoenician colonisation, and more specifically with the mining of silver in the area of Huelva and Seville. That is to say, that the stelae would represent the chiefs capable of providing the necessary labour for the development of Tartessus in the midst of Phoenician colonisation, although without being able to determine whether this was done as slaves or voluntarily in view of the opportunities offered by the economic development of Tartessus, an idea that we have also insisted upon (Celestino 2009; 2023).

In 2010, Marta Díaz-Guardamino presented a comprehensive study of a significant number of stelae, including a catalogue, in which she brought together not only the warrior stelae, but also other manifestations of rock art that she considered to be from earlier traditions. She based her study on the iconographic analysis of the stelae, making them part of a diachronic phenomenon that began in the 6th millennium BC and ended in the 8th century BC as a result of Phoenician colonisation. This hypothesis is based on the social interpretation of the stelae, delving into the importance of the past to understand their development, their contextualisation, their social links and their relationship with the landscape. She also associated the stelae of the southwest with other similar phenomena documented elsewhere in Europe, such as in south-western France, northern Italy, and even Scandinavia. In the latter case, she believed that there is a common nexus that linked them ideologically, a hypothesis that she has recently insisted on with arguments based on the representations in rock art and new archaeological approaches (Díaz-Guardamino *et al.* 2022; Ling *et al.* 2014; 2024). The stelae, in short, would have played an essential role in reinforcing social ties. This idea of a warrior ideology with foreign origins had already been proposed by Harrison (2004) in his monograph on stelae.

The link between the iconography of the stelae and the landscape is reflected in two papers published in 2011, at which time new methodologies had been developed for the analysis of the landscape as well as for the analysis of stelae with greater technical detail. Two of these papers were presented in a volume entitled «Atlantic Europe in the first Millennium BC», published by Tom Moore and Lois Armada (2009). The first calls for the analysis of the spatial distribution of the stelae based on Geographic Information Systems (GIS) and, whenever possible, on the intensive prospection of the immediate terrain where the stelae were found, even if they are, in theory, out of their original context (Celestino *et al.* 2011). The second work, also closely related to its location in the geographical space and archaeological environment, is based on the analysis of the very interesting stela from Almadén de la Plata (García Sanjuán *et al.* 2006), where a warrior and a woman are represented on the same scale, something that had already been detected in other stelae, although not in such an explicit way. The authors' proposal is based on the memory of the landscape and its relationship with the surrounding sites, regardless of their chronology, for which intensive prospection is used. This same hypothesis is shared in more recent works with Díaz-Guardamino.

In the same year, 2011, the proceedings of a meeting held as part of the IV Jornadas Raianas de Sabugal, held two years earlier and coordinated by Raquel Vilaça, were published. The first thing that is striking about that meeting is that it addresses warrior stelae and menhir statues in the same way, in line with the thesis of Díaz-Guardaminos; but it is important to note that it is emphasised that they were created in Pre- and Proto-historic times. Galán continues to situate them in the Bronze Age and makes them heirs to the cave paintings of previous phases, as Bueno defended in 1990, but always maintaining the

importance of these monuments in relation to the landscape, something that has become generalised in recent years, although with different nuances. He also argues that representations such as the chariot are ideograms, i.e., that they were engraved without actually existing, something that could be extended to other elements such as shields, which have not been documented in archaeological contexts either. The monograph is of great interest in that, in addition to generalising the study of stelae in close relation to the territory, analyses are carried out using new methodologies for a more detailed study that has now become widespread. The most novel proposal is perhaps that of Vilaça and her collaborators (Vilaça *et al.* 2011), who, after presenting two new examples (Pedra da Atalaia I and II and Adeia Velha), interpret the stelae, as a hypothesis, as markers of border areas where intergroup negotiations could have taken place, the stela being the landmark that endorsed them or kept them in memory. There would also have been a control of communication routes that would have been directly related to the gold and tin trade, an idea that is widespread in the bibliography of the stelae and which has recently been vindicated once again (Rodríguez Corral and Rodríguez Rellán 2023; Celestino 2023, 36).

Finally, in the Sabugal volume, a new typology is presented, which in reality only addresses the numerous monuments that have appeared in the last decade. New subtypes are added according to the iconography, and the presence or absence of certain elements is detected according to the geographical area where they appear. Although the geographical zones are basically maintained, the fact is that as more specimens appear, the zones become blurred and the spaces that separated them are filled in with new finds. Consequently, and for the first time, it is proposed that they be called «Western Peninsular Stelae», given the concentration of monuments on practically the entire Atlantic side of the peninsula (Celestino and Salgado 2011). In this sense, in recent years, new examples have been discovered in the Duero and Miño valleys, which only confirms this denomination.

After a short hiatus in which, nevertheless, new stelae were published and where new methodologies aimed at resolving some technical aspects of the stelae were studied in depth, the work of Ralph Araque Gonzalez was published in 2018, with 123 known stelae, addressing intercultural and iconographic aspects in the western Mediterranean between the Late Bronze Age and the Early Iron Age. Araque opens up a new line of research that has so far received little attention: the technological elaboration of the stelae, an approach that has proved to be very effective in recent years and which focuses on the artist(s) rather than on the person(s) depicted. He defends the origin of the stelae in the Sierra de Gata area as a derivation of the stelae from Alentejo and dates them to between the 13th to 12th and 9th to 8th centuries BC. He thinks that the stelae are made with an internal language and, therefore, do not indicate roads for outsiders, but for the communities themselves who made them and who know where they are located. Ultimately, it presents a commitment to experimental archaeology, which he has been developing with his team to date and, hopefully, in the future, because of the interesting data derived from these analyses.

The intensification of spatial analyses carried out on geographically well-defined groups is reflected in an article written as a result of the discovery of the Cabeza del Buey V stela (Pavón *et al.* 2018), which details the archaeological remains from the Chalcolithic to the Late Bronze Age in the area in order to relate them to the stelae of the area. This study is indebted to the one carried out by Costa (2013) on a large area of the Guadalquivir valley, although, curiously, the authors do not include it in their work. This association of sites lacking archaeological intervention or even isolated archaeological elements in the landscape with the stelae is undoubtedly very relative and inevitably leads us to look out for confirmed landmarks of a Late Bronze Age chronology, which was attributed to the stelae by the authors.

It is in the last five years that studies on stelae have taken on great relevance thanks to the new methods and techniques used for their study which, although they have not yet been able to resolve the doubts they generate, have at least managed to introduce new tools that allow us to make some progress in our knowledge of the stelae (Celestino and Paniego 2021). A particularly important work in this respect is the first systematic introduction of petrological and geochemical analyses of the supports of stelae, specifically on a large group of stelae from the Tagus valley (Merino *et al.* 2018). The work carried out by Araque Gonzalez and his collaborators on another group of stelae, in this case from the Zújar valley, also follows this line, with a multidisciplinary approach where, in addition to petrographic analyses, metallurgical analyses are incorporated and complemented by experimental archaeology (Araque Gonzalez *et al.* 2023).

Also with a large multidisciplinary team, work has been carried out on some Andalusian stelae (Díaz-Guardamino *et al.* 2019) as well as on the rock carvings of the Zújar using digital images, petrography or X-ray fluorescence (Díaz-Guardamino *et al.* 2022; Díaz-Guardamino 2023). Also noteworthy are the detailed studies carried out on the Cordovan stela of Pedro Abad II through photographic documentation with grazing light (Martínez Sánchez 2018) or on the stela of Luna in Zaragoza (García Arilla *et al.* 2021), where, in addition to petrographic analysis,

structured light digitisation of the engravings is used to differentiate the different engraving techniques, although not the tools used.

Only in recent years has an effort been made to discover the technology with which the elements depicted on the stelae may have been made. The first attempt focuses on the shields depicted on the stelae, based on the leather specimen from Clonbrin: how they would have been made, what the function of the V-shaped notches would have been and how they would have been distributed throughout Europe (Del Reguero 2019). However, the greatest effort has undoubtedly been directed at finding out how the stelae were carved. This experimental part related to the making of the stelae has not been adequately addressed in the more classical studies, where it was taken for granted that most of the motifs had been made by carving, without evaluating the instruments with which they could have been carved. The exception were Soares and Monteiro (1977), who noted that most of the pieces had been decorated by chipping. This is the technique also defended by Enríquez and Fernández Algaba (2010) after an exhaustive analysis of the stelae in the Archaeological Museum of Badajoz. However, none of them made any bets on the chisel or the tool with which they were decorated, whether it was stone, bronze or iron. This is a subject that has hardly been touched upon in the literature despite the introduction of increasingly sophisticated techniques for detecting new decorative elements.

Recently, two studies have been published in which, thanks to experimental archaeology, the instruments used in carving the stelae have been determined; in the first one, a bronze chisel was used (Gutiérrez Sáez *et al.* 2020); in the second one, which is more elaborate and involves a large multidisciplinary research team, the use of iron in such early times is supported, ruling out the possibility of using bronze tools (Araque Gonzalez *et al.* 2023).

3. The economic territory of the stelae

A subject that has only been addressed in depth in recent years is that of the economic resources linked to the development of the stelae. While it is common to link the Portuguese stelae from the Beira and those that appear around the Douro and Minho valleys to the extraction and trade of tin, it is more difficult to associate the large group of stelae from the Zújar and Guadiana valleys to a specific economic activity. It should be borne in mind that most of these stelae have been located in the so-called 'Siberia of Extremadura', a vast territory where archaeological remains of any phase prior to the Roman conquest are very scarce, even more so if we restrict ourselves to the Late Bronze Age and the First Iron Age.

Studies of economic resources are closely linked to spatial analyses of the distribution of the stelae, which consider that their exploitation or the control of their transit plays a fundamental role in their distribution. Among these resources would be the agricultural and road resources already outlined by Galán (1993), the aforementioned exploitation of labour (Moreno 2000) or mining and metallurgical resources, such as gold, copper, cinnabar or tin (Moreno 2000) (Quintana and Boixereu 2006; Berrocal 2012; Pavón *et al.* 2019; Zarzalejos *et al.* 2012; 2020; Miguel and Morales 2022; Rodríguez-Corral and Rodríguez-Rellán 2023; Celestino and Paniego in press).

The distribution of the stelae over a large part of the western part of the peninsula responds, in my opinion, to a movement of people from the centre-north of Portugal, the west of the northern Meseta and the south of Galicia towards the valleys of the Tagus, Guadiana and Guadalquivir, probably in search of a privileged location in view of the economic strength of Tartessus. This implies that we would be in favourable territories, the main rivers, for commercial exchange, as these stelae contain the first carvings of objects of Mediterranean origin (Celestino 2013, 361); a point that will be dealt with in one of the chapters of this book.

We must not forget that more than 50% of the stelae are found in the Guadiana and Zújar valleys, a territory that is not particularly suitable for agriculture, although it does produce very good pastures for extensive livestock farming. But it does not seem that Tartessus was interested in livestock, at least as the main product. It would seem that there were some products of strategic importance for the new Mediterranean colonisers that only the warriors depicted on the stelae could control and facilitate, such as gold and tin (González Ruibal 2004; Pérez Macías 2013; Hunt and Ling 2023; Rodríguez-Corral and Rodríguez-Rellán 2023; Celestino 2023, 36), perhaps even before the interest in silver as recorded in Greek sources (Woods *et al.* 2019; Hunt and Ling 2023).

The discovery of numerous golden artefacts in the areas where stelae proliferate is truly revealing (as is the fact that they do not appear in the core of Tartessus), especially if we take into account that they are always concealed, which increases their importance and the possibilities of finding new artefacts in the future. In this sense, the role that the geographical environment of Cordoba may have played as a mining centre since the Phoenician colonisation has not been taken into account. An area where the presence of gold prevails and which, thanks to the great trade route of the Guadalquivir, would become an extremely important territory for activating a circuit towards the Lower Guadalquivir and Cadiz, as well as acting as an intermediary with the Guadiana Valley. It should be borne

in mind that from Cordoba, through the Guadiato and Pedroches valleys, it is possible to directly access the valley of La Serena, the main nucleus of the stelae, where there are also a good number of Tartessian buildings hidden under burial mounds, including Cancho Roano, La Mata and Casas del Turuñuelo; but also where the settlement of Entrerríos and the well-known necropolis of Pozo de Medellín can be found. Furthermore, Medellín was the first Roman colony in the Guadiana region founded by Metellus and dependent on Cordoba until the 1st century, when Mérida was founded (Monterroso *et al.* 2023).

The other product of importance for the activation of trade between the Atlantic and the Mediterranean was undoubtedly tin, perhaps the original reason for the eastern colonisation, although it was silver that took over the leading role, probably because the sources we have are Greek, almost 200 years after the first settlements of the Phoenician colonisers, when tin already had a much lesser economic impact due to the introduction of iron. But even some classical historians and geographers echoed its importance, such as Strabo, Pseudo-Aristotle or Avienus (cf. López Castro 2019, with bibliography). As we know, tin is especially abundant in the so-called «Iberian tin belt» that extends over a large part of the northwestern part of the peninsula, and its commercialisation towards the Mediterranean through the Phoenician colonies in the south of the peninsula has already been discussed by several researchers (Mederos 2009; Pérez Macías 2013, 465; Comendador *et al.* 2017, 138; Maunier 2019), once again asserting its importance in recent years, now linking it to the stelae, whose characters may have served to endorse this trade route (Rodríguez-Corral and Rodríguez-Rellán 2023; Celestino 2023, 35).

Another product that must have been important for initiating new trade networks with the interior of the peninsula must have been cinnabar, which has been somewhat less well understood in former research due to the lack of specific analyses. The significance of cinnabar in trade with the south of the Peninsula was already exposed in two articles by Maluquer de Motes (1983; 1985), and this hypothesis could recently be supported by multidisciplinary studies on its production (Zarzalejos 2023). Furthermore, we should not ignore the discovery of mining mallets and fragments of processed cinnabar at the Bienvenida site in contexts from the 7th century BC (Zarzalejos *et al.* 2020), a site located in the Alcudia valley, next to the Zújar and Pedroches valleys, where a significant number of stelae are concentrated.

Finally, one topic must be mentioned that has been very present in Tartessian bibliography: the low population density of the indigenous people at the time of Phoenician colonization. It is clear that the important mining resources of the Iberian Peninsula were decisive in promoting colonization, a circumstance that required an abundant workforce for mining exploitation. Colonization, therefore, entailed a significant increase in the population that was necessary to significantly increase the mining production, which had already been taking place since earlier stages to supply the Atlantic market. In addition to building mining settlements, it was necessary to create production centres for the extraction and transformation of metals, inland transportation routes to facilitate their distribution, and anchorages and shipyards for the commercialization of these metals along sea routes throughout the Mediterranean. Over time, the anchorages would become harbour settlements and walled port cities, where a large workforce would be needed for their construction. Social diversification would entail labour specialization and the creation of craft centres to satisfy an increasingly demanding population. And finally, the participation of a good number of farmers and ranchers would be needed to supply the entire population, which in a very short time grew rapidly and exponentially (Celestino 2023, 35). Now, entering into more speculative territory, I cannot help but raise as a hypothesis to justify this demographic growth that the warriors represented on the stelae could also have exercised their power and control of the territory to supply labour to the core of Tartessus, which was in full development and, as we have pointed out, an increasingly dynamic economic activity emerged thanks to the continuous arrival of settlers to the South of the Peninsula. This is in comparison a very difficult (if not impossible) line of research due to its archaeological invisibility and the absence of written sources that enlighten us on its circumstances, the exception of which, undoubtedly lukewarm, is Justin's epitome to Pompey Trogus on the reforms of King Habis in Tartessus (Just. Epit. XLIV, 4, 13) in which it is indicated that the creation of the seven cities was carried out with servile people; but of course, we are talking about a text written in the Roman era and about a mythical king. Only from the Iberian period do we have a little more information, but it is insufficient to build a solid theory in this regard (Crespo and Alvar 2019). Furthermore, the same can be said of other products that hardly leave a trace in the archaeological record, such as salt, skins, essences or wax that have also been suggested for other peninsular areas during protohistory.

4. The protagonism of the diademed or female stelae

The first stela with a diadem appeared in the locality of Torrejón el Rubio and was an anomaly within the list of stelae known up to that time: in fact, the first person to dis-

close it associated it with a female personage (Fernández Oxea 1950, 299), while Almagro Basch considered that it represented a sacerdotal figure (1966, 86). Until 2001, the so-called diademed stelae were treated as a separate type due to their originality and, above all, because they seem to derive from types that appear to originate from the Bronze Age, if not earlier. But the appearance of the stela from El Viso III, published in 1980, was the first indication of the simultaneity of representing the warrior and the «diademed» figure in the same space and in equal proportions. However, those who published the stela (Bendala *et al.* 1980, 385-387) interpreted the central figure as a poorly crafted chariot. Only two years later, the stela from Capilla I was published (Enríquez and Celestino 1982), and in 1984, the second from Belalcázar (Enríquez and Celestino 1984, 243). Very close to the previous ones, the one from El Viso V appeared (Bueno *et al.* 1984, 380) and the one from Zarza Capilla II, which is still unpublished. These findings gave rise to the interpretation of the central figure of the stela from El Viso III as a «diademed» figure associated with a female personage, giving meaning at the same time to other anthropomorphic representations wearing the diadem, such as the dancers from Ategua or Zarza Capilla III (Celestino 2001, 248-250). This hypothesis seemed to be ratified years later when the stelae from Almadén de la Plata II (García Sanjuán 2006) and Almadén II (Blanco and García Bueno, 2009) appeared, two very explicit cases of the union of both representations on the same stela and in equal proportions.

Although there seems to be no discussion about the association of these diademed figures with women (Santos 2010), the recent findings of two diademed stelae in Cañaveral de León, in the north of the province of Huelva, and especially the second stela recently published in the press, forces us to rethink the association of these «diademed» stelae with women as most researchers had defended until now; However, we await their publication in order to know the interpretation made by the team of archaeologists who have found them in the place where they appeared and who are in the process of studying them.

5. The meaning of the figures depicted on the stelae

The anthropomorphic figures in the scenes on the stelae have generally been interpreted as warriors, although they have also been considered to represent tribal chiefs, priests or gods. Wherever they have been interpreted as warrior chiefs – the most widespread position – the stelae are thought to have a direct relationship with death, either as markers of tombs or as cenotaphs, regardless of whether they have also served as territorial markers or signposts of trade routes. For some, these warriors were actually lords who controlled the slave trade to the Tartessian core (Moreno Arrastio 2000). Others prefer to interpret them as heroes with their attributes (Harrison 2004) or divinised characters following the Eastern model, which therefore only appeared after the colonisation of Tartessus (Celestino and López-Ruiz 2006). There are also those who relate the engraved figures to the foundation rites, so that when the warrior and the diademed woman are depicted together they would be alluding to the divine diarchy (García Sanjuán *et al.* 2006). And, finally, there are those who directly associate the carved figures with deities (Tejera and Fernández Rodríguez 2012).

The limited knowledge we have of the archaeological context of the stelae, although increasingly related to the funerary world, facilitates this varied assortment of arguments which, in reality, lack a solid foundation. When they have appeared in archaeological contexts, they have never appeared in a primary position, as in the case of the stela documented in the sanctuary of Cancho Roano, reused as a threshold at the entrance to the building in Phase A-II (Celestino 2022, 300). More significant is the Setefilla stela reused to cover a double burial from the 7th-6th centuries BC (Aubet 1997); although the discovery of a total of 16 undecorated stelae prepared to be placed in the ground, directly related to the necropolises of the First Iron Age, is also very revealing (Celestino and Paniego in press). For this reason, perhaps the stelae of Setefilla are the most significant for interpreting the characters represented; a circumstance that becomes even more significant if we review the discovery of the group of stelae in Hernán Pérez, where, together with the warrior stela, six stelae-pebbles were found, or the supports prepared to be driven into the ground, but without decoration, related to the stela of San Martín de Trevejo, in Cáceres, or in several areas of the Zújar valley (Celestino 2001, 279-280). The latest findings in the excavation of the necropolis of the Las Capellanías estate in Cañaveral de León, on the border with the province of Badajoz, only reinforce this interpretation, although at present we only know of the study of the first of these (Rivera *et al.* 2021).

6. The chronology of the stelae

The bibliographical references to the chronology of the stelae are almost as extensive as the number of authors who have addressed them, so it is not worth making a long list here of proposals that have been made since the first stelae was found in Solana de Cabañas. This is undoubtedly another of the main issues that we have not been able to resolve. The most common is to find them classified as being from the Late Bronze Age; in a 1990 paper I still de-

fended this chronology, justifying the inclusion of objects of Mediterranean origin in the so-called «pre-colonisation» period. Today I no longer support this hypothesis, and although its origin could be traced back to the Late Bronze Age, its maximum expression seems to have developed in the First Iron Age (Celestino 2023, 35). The most varied arguments have been used to justify the different proposed dates, such as the presence of leaf-shaped swords or the «carp's tongue» swords that appear on some stelae; the low-cut shields, depending on their origin as we have already seen, are also used; the geometric style of some of the scenes, as in the case of the one at Ategua; or the origin of the chariot, the musical instruments, the helmets, etc. Therefore, although it is difficult to chronologically situate the origin of the stelae, which was probably in the Late Bronze Age, it seems that they reached their peak between the 8th and 7th centuries, while their disappearance must have occurred in the 6th century BC, coinciding with the so-called «Tartessian Crisis», which in turn coincides with the rise of the Tartessian culture in the middle Guadiana valley (Rodríguez González 2022; Celestino 2023). In this sense, and by way of hypothesis, perhaps the large buildings under tumuli in the middle Guadiana valley are the expression of the power that the characters represented on the stelae attained after the crisis of the Tartessian nucleus, which is why Cancho Roano, for example, preserves one of these stelae at the entrance as a symbol of inherited power.

7. More questions to be answered

As we have seen, most of the discussion on stelae has focused on the cultural influences that generated them, their functionality and their chronology, although other aspects have been touched upon that are gaining more and more interest in research, such as the technology with which they were made. But there are other issues that have hardly been taken into account when analysing these monuments and which could help us to understand them better.

The first question is why the stelae, both of warriors and with diadems, are never found near the coast, but inland, and therefore far from the maritime trade routes. This adds to the fact that the figures depicted on the stelae acted as intermediaries with the Phoenician colonisers who, as we must not forget, also settled at the mouth of the Tagus (Arruda 2000; Sousa 2020).

Another issue that has gone unnoticed in the bibliography on the stelae is their size. Some reach more than 2 metres in height, while others barely reach 0.40 m, always referring to those that have been preserved intact. This fact is very relevant because it opens up a number of ways of interpreting them. The large stelae seem to have formed part of the landscape for which they were made, and here we could consider stelae of up to 1.20 m to be generous. The question is what was the function of the stelae between 0.40 and 1.20 m, some of which were made with a strongly schematic style. They could be marking a tomb, of course, but we should also consider the idea that they could be domestic objects of worship, as idols or ancestor worship, something very common in all religions, both eastern and western Mediterranean.

It is also striking that the elements represented are so homogeneous and of a personal and movable nature. This responds to a more Atlantic than Mediterranean way of thinking. However, it seems that with the passing of time and thanks to the influence of oriental colonisation, some stelae already display scenes of a certain composition with an evident Mediterranean flavour, as in the case of Ategua or Zarza Capilla III, where the participation of the community is relevant and where the introduction of dance and music show the degree of social complexity achieved.

Are the objects depicted on the stelae real? This has also been an issue that has been addressed on occasion, although it has not been discussed in great depth. The discussion has mainly focused on the shields and chariots. In the case of the shields, the answer seems to be simple, because, having been made of wood and leather, it is difficult for them to survive in the archaeological record; in fact, only the Irish shields preserved in peat bogs or, obviously, the Central European and Scandinavian bronze shields have been documented. Nor does it make much sense that weapons such as swords or spears, which are well documented on the Iberian Peninsula, are depicted and that the shields were drawn without a model. The case of the chariots is more striking because they are all depicted in the same way: from a bird's eye view or overhead position. The hypothesis that this is an ideogram or that they never really reached the peninsula is difficult to defend; firstly, because the chariot does not appear on the simplest stelae, thus forming part of the most complex compositions; secondly, because if a model from the Mediterranean had been copied, they would have been drawn as they appear in the images we know from the Greek or Near Eastern world, i.e. from the front, showing the elevation of the chariot body and the upright horse-drawn chariot; and, thirdly, because, in my opinion, the chariot symbolises the warrior's means of transport in his transit to the Beyond, in harmony with the artistic expressions of the Eastern Mediterranean, hence the fact that they are drawn in this arrangement, most of the time under the warrior's feet.

Another question that has received little attention is that of the craftsmen who made these stelae. There is no doubt that many of them show very similar styles that reveal a single hand in execution; this is the case of stelae II and III from Torrejón El Rubio, those found in Castelões,

the stelae from the municipality of Écija and the large group of monuments from the Zújar valley. The question, therefore, is whether there is a craft specialising in engraving stelae, for in this case, they could be grouped by style to see if the elements represented are repeated. However, there are some very crude stelae which seem to have been executed by people who were not involved in any particular style, and which coincide with the smaller ones; in other cases, the supports on which the different motifs were engraved are of very poor quality, which affects the category of the elements represented, since engraving on limestone, granite or slate is not the same thing. This is an area of study that has scarcely been addressed and which could help to understand the very concept of stelae.

A recurring theme over the years to help classify stelae has been the limitation of the geographical areas where they have been found. Although it is true that new specimens are appearing every day, diluting these geographical limits, it is also true that styles and compositions typical of specific territories continue to be perceived, so that speaking of geographical areas is still valid, even if they are somewhat blurred.

Finally, some researchers have made much of the fact that stelae have been found at river fords, mountain passes or trade routes, but could they have been found elsewhere? It seems to be logical that the stelae should be close to where humans carried out their activities, and these have always been the areas where cultures have developed. Even in the event that the stelae are related to necropolises, these would be located at strategic points due to their logical relationship with the settlements. It would be very strange for a cultural phenomenon such as stelae to have been detected in isolated areas, without resources or communication with other spaces.

But there are many other questions that research has not fully addressed and whose answers we are still far from knowing; for example, few have asked whether the stelae could be showing a certain competitiveness between different chiefdoms through the elements represented. Some think that the stelae actually represent the cult of a heroic ancestor; an idea with profoundly Eastern roots that could have been transmitted throughout the Mediterranean before the Phoenician colonisation, and therefore would have reached the peninsula thanks to contacts with the central Mediterranean during the Late Bronze Age (Ruiz-Gálvez 2019).

The truth is that the incursions into subjects related to iconography, anthropology, structural Marxism, symbolism and others have not been able to unravel the meaning of the stelae, or at least reach a minimum consensus. For this reason, in 2011, coinciding with the publication of the Sabugal monograph, edited by Raquel Vilaça, an important turn was taken and a more positivist approach was chosen in order to unravel certain aspects which until then had not been touched upon, or had been addressed only in a very cursory manner. This is when new methodologies to gain a better understanding of the methods of production, new techniques to analyse the engraved elements in greater detail or to increase the number of analyses to gain a better understanding of the origin of the supports, take on greater importance.

In short, there are many questions that remain to be answered and we will certainly have to wait for some time to resolve them, but the important thing is to move forward incorporating all the working methods that new technologies offer us today, where artificial intelligence can undoubtedly play a key role.

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CHAPTER 3

New Perspectives on the Spatial Distribution and Typologies of Western Iberian Stelae

Pablo Paniego Díaz

Abstract

The number of known stelae has continued to increase, especially in recent decades, bringing their count close to 170 specimens. This rise requires a revision of studies concerning their distribution, incorporating data from the latest findings and revisions conducted on previously published research. This paper presents the individual and collective arrangement of the items depicted on the stelae, allowing for an examination of the areas of distribution of the represented objects.

Based on the individual study of the items and their combined occurrence, a new typological classification of stelae is proposed, divided into three classes. Additionally, an attempt is made to elucidate the reasons behind this distribution by considering the type of society that engraved the stelae.

Keywords: Warrior stelae, Diadem stelae, Final Bronze Age, Early Iron Age, Chiefdom, Power representation

Resumen

El número de estelas conocido no ha parado de aumentar, especialmente en las últimas décadas, acercando su número a los 170 ejemplares. Este aumento ha hecho que los estudios sobre la distribución de las estelas deban ser revisados, incorporando los datos de los últimos ejemplares y las revisiones llevadas a cabo sobre los ya publicadas. En el presente trabajo se muestra la distribución individual y en conjunto de diferentes ítems presentes en las estelas, permitiendo ver las áreas de distribución y concentración de los objetos representados.

A partir del estudio individual de los ítems y de su aparición en las estelas combinadas con el resto de objetos se propone una nueva clasificación tipológica de estelas, dividida en tres clases. También se intenta explicar el porqué de esta distribución atendiendo al tipo de sociedad que grabó las estelas.

Palabras clave: estelas de guerrero, estelas diademadas, Bronce Final, Hierro I, Jefatura, Representación del poder.

1. Introduction

Decorated stelae represent one of the most compelling phenomena in Protohistoric Iberia, garnering significant attention from both peninsular and non-peninsular scholars. This keen interest primarily arises from the lack of consensus surrounding key aspects such as their purpose, chronology, or the identities of the figures depicted. The steady influx of new discoveries has played a pivotal role in ensuring sustained interest in these stelae, perpetuating a continuous growth in the questions posed. The increase in known stelae has been particularly pronounced from the 1970s onwards, with an average discovery rate of 2-3 per year (Fig. 1).

As a result of this quantitative increase in the number of stelae – which now approaches 170, excluding those

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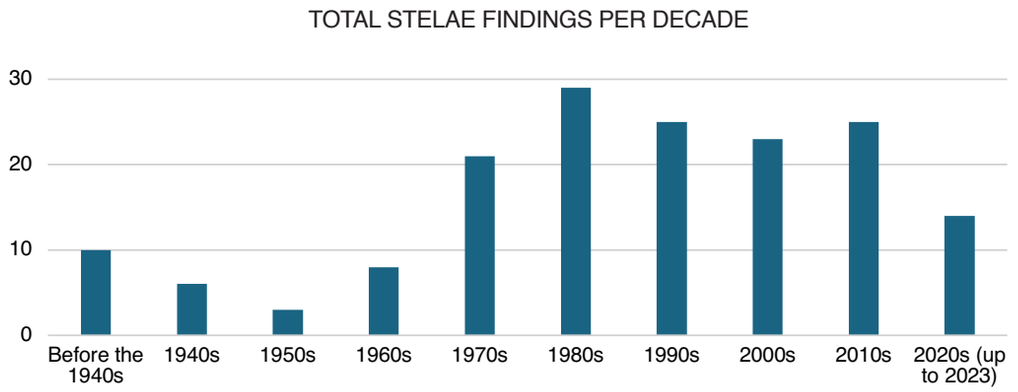

Figure 1. Comparison of finds of stelae per decade.

known as "estelas-guijarro"[1] or "ídolos-estela" – there has been a substantial change in their geographical distribution from that observed in earlier studies. Thus, they are no longer referred to as Extremadura stelae, but rather as Southwestern stelae, and in recent years, the term Western stelae has become more prominent.

With the exception of the Luna stela in Aragon and the three located in southeaster France, all stelae are found along the peninsular Atlantic facade, within a triangle whose vertices are situated in Ourense, Malaga, and the Algarve, with the easternmost specimens located in the central area of the province of Ciudad Real (Fig. 2). Their distribution is highly uneven, with a notable concentration of stelae found along the Zújar River and its mouth at the Guadiana, accounting for almost 40% of the total, while approximately 20% are located in each of the valleys of the Guadalquivir and the Tagus.

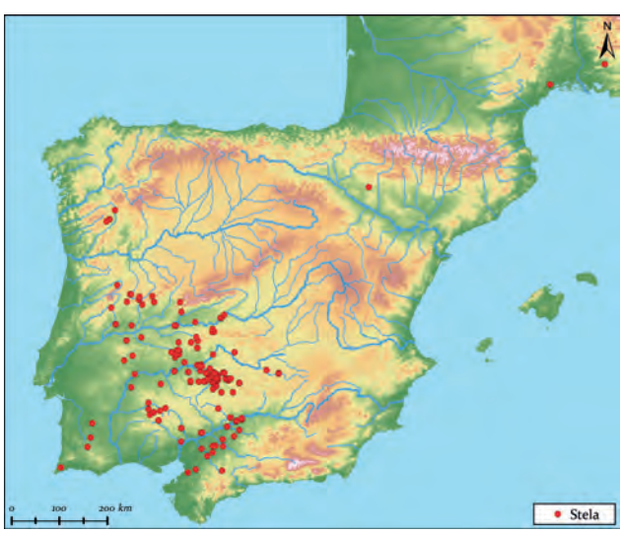

Figure 2. Distribution of stelae in Western Europe. Reconstruction of the paleo-shoreline from the Ancient World Mapping Centre at the University of North Carolina at Chapel Hill.

[1] We have chosen to keep the term "guijarro" in Spanish by convention. The term could be translated as pebble or riverstone, although archaeologically the term "guijarro" is understood as a rounded stone, usually due to the action of water, without considering that its dimensions are larger than those assumed for pebble.

Equally interesting is to observe how this is clearly an inland phenomenon. Apart from the stelae of Vila do Bispo (Figueira) and Utrera (Torre Alocaz), which were found in locations near the coast, all the others are located in territories further inland. In the case of the latter, it is necessary to remember that the coastline has changed substantially and that during the 1st millennium BC, the so-called *Lacus Ligustinus* flooded areas that are now emerged.

Another general characteristic of the distribution of stelae is their absence in the core area of Tartessos, leading to the consideration that the individuals and/or societies represented on the stelae, who acquire the prestigious goods depicted from Tartessos and the Phoenician colonies, were likely responsible for controlling the exploitation and trade of products required by these peoples (Celestino 2023, 35–36). Furthermore, it is possible to outline a significant route between Córdoba and the middle basins of the Guadiana and Tagus rivers through the Zújar valley, which was the main communication route from the Guadalquivir to the north before the foundation of *Augusta Emerita* and the enhancement of the Vía de la Plata (Silver Way) (Celestino & Paniego forthcoming). It is noteworthy, however, the presence of stelae in all the main tributaries of the Guadiana except for the Matachel River, an area rich in metals and subject to intense exploitation in the Roman period (Domergue 1987; Heras 2016).

2. Spatial Distribution of Stelae

a. Basic and Complex Typology

The stelae have been classified according to geographical and typological criteria. In the case of the latter, perhaps the most comprehensive and complex one is the typology by Celestino and Salgado (2011), who divide them into four main groups with up to three subcategories each. A level of detail that complicates the extraction of data and conclusions.

Given this, we believe it is both possible and necessary to employ a simpler typology, even if it entails sacrificing

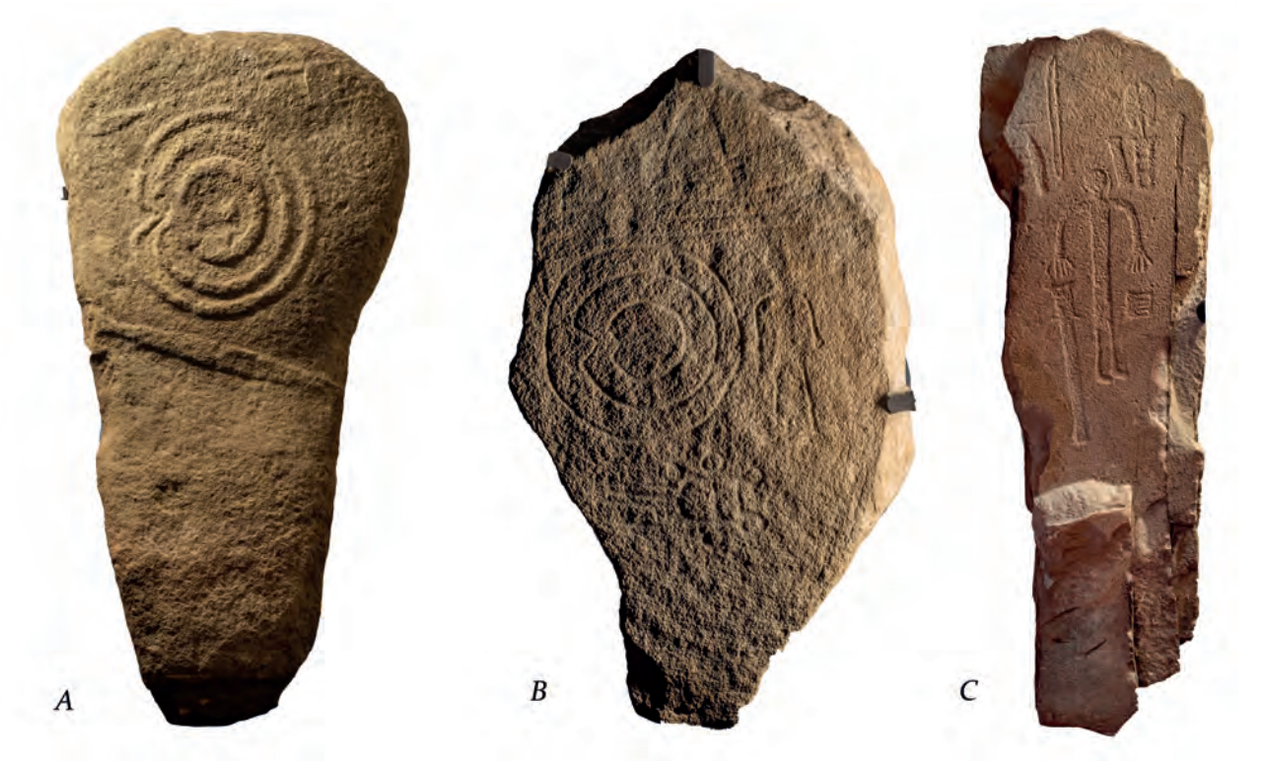

Figure 3. a) Example of Type A1: Sabugal I (h: 158 cm), b) Example of Type A2: Zarza de Montánchez (h: 176 cm), and c) Example of Type B: Capilla III (h: 134 cm). Different scales. (Photographs: Ángel. M. Felicísimo, KRAKEN Group).

some level of refinement in the results. However, we argue that it is feasible, and even advisable, to address certain elements individually, while still acknowledging the importance of the combinations of objects depicted on the stelae.

In light of these considerations, and to some extent revisiting typologies previously proposed by Almagro Basch (1966, 197–198) and Pingel (1993) for the stelae classified as Type II[2], we suggest that stelae can be divided into two main groups: Type A and Type B. The last one is characterized by the prominence of the shield, while the latter features the position of this element either equivalent to or subordinate to the anthropomorph, sometimes even disappearing altogether (Fig. 3c).

Within Type A, a subdivision can be made between the more straightforward stelae that consist solely of weapons – shield, spear, sword, and occasionally a helmet – (A1) (Fig. 3a), and those that incorporate additional items like fibulae or mirrors. Furthermore, within this latter category, stelae where a human figure appears in a clearly subordinate position would also be categorized (A2) (Fig. 3b).

Type A1 stelae account for over 7% of the total[3] and are mainly concentrated in two areas: Beira Interior and

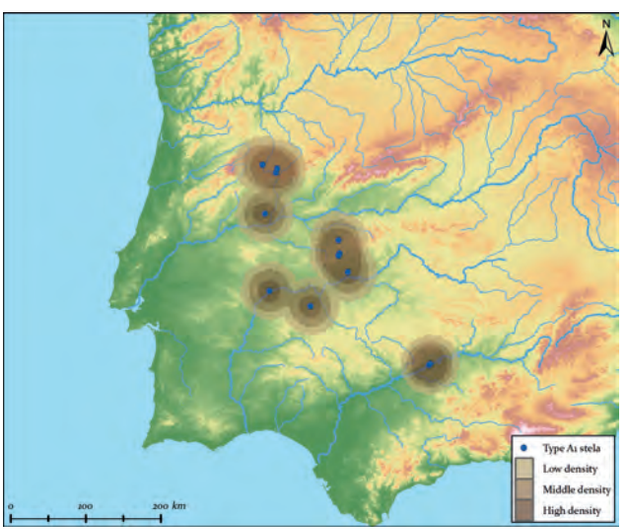

Figure 4. Distribution of Type A1.

Trujillo-Montánchez, the latter linked to the Guadiana basin, where isolated specimens were also documented. Lastly, in the middle valley of the Guadalquivir River, stelae of this group are also found (Fig. 4). Therefore, while broadly covering the distribution areas of the more complex stelae, it is notably absent in certain significant areas, such as the Zújar valley.

Type A2 stelae represent around 14% of the total. Unlike the previous type, they are entirely absent in the Guadalquivir and Guadiana valleys, except for the Jabalón and the fragmented and missing specimen of Valdetorres II – therefore considered uncertain. Thus, examples of this

[2] Stelae classified as Type I are known as Alentejan stelae, representing a typology significantly different from those discussed here. Pingel categorizes them into IIa (sword, spear, and shield), IIb (sword, spear, shield, and other objects), and IIc (appearance of the anthropomorph); a tripartite division that we partly uphold, albeit with modifications to the criteria for placement in categories b and c.

[3] A significant number of stelae have not been categorized due to fragmentation, which suggests that their actual number could be even higher.

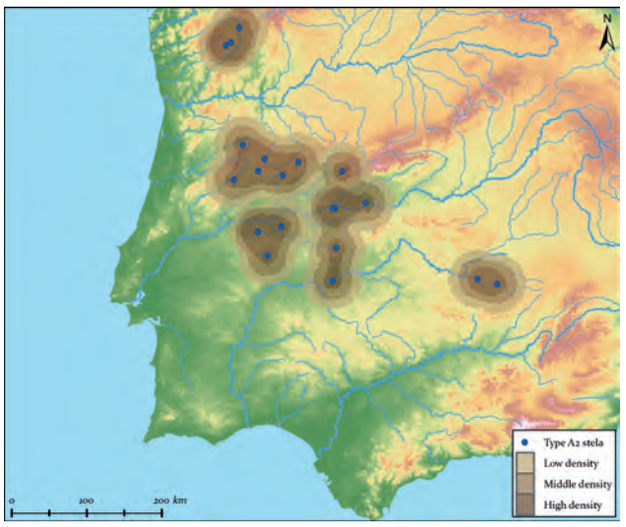

Figure 5. Distribution of Type A2.

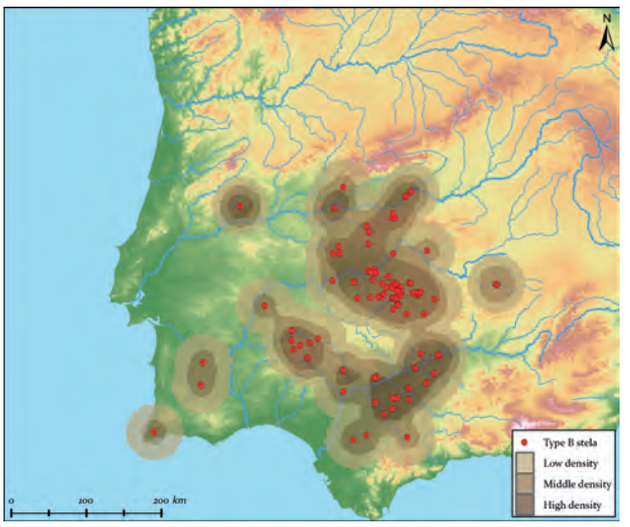

Figure 6. Distribution of Type B.

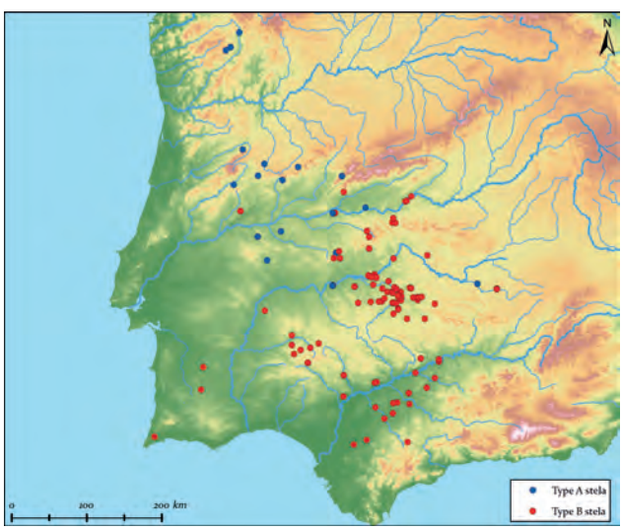

Figure 7. Distribution of Types A2 and B.

group are concentrated in the valleys of the Tagus and the Douro rivers, the most northern specimens even surpassing said river course (Fig. 5).

Type B is the most numerous group, comprising nearly 69% of the total count (Fig. 6). Its distribution is predominantly southern compared to the former types, centred in the basins of the Guadalquivir and the Guadiana rivers, with some specimens also found in the middle valley of the Tagus, alongside the isolated concentration in Castelo Branco and those in southern Portugal. Notably, the most significant concentration lies in the Zújar valley, accounting for 40% of the total.

Examining the overall distribution of the two most complex groups, Type A2 and Type B (Fig. 7), reveals how implantation areas are distributed. With the exception of a few specimens in the areas of contact between predominant zones, such as those in the Jabalón valley and the cluster in Castelo Branco, two distinct zones seem to be clearly defined: a northern one occupied by Type A2 and a southern one where Type B stelae are located.

Noteworthy are the diadem-stelae (Santos 2010, with bibliography), which can be divided into two groups based on the support. One of these groups would use stelae as their support in the strict sense, and they would be included in Type B, especially considering the existence of stelae such as Almadén II, Almadén de la Plata, or El Viso III, where a diademated figure shares the spotlight with anthropomorphs with warrior attributes. The other group consists of the so-called "ídolos-guijarro" or "estelas-guijarro". This criterion has been used to determine whether to include them or not in the aforementioned Type B.

However, without going into too much detail, we believe it is necessary to outline a typology of stelae with diadems or headdresses based on their compositional features, allowing us to divide them into four main categories.

The Type I (Fig. 8a) is characterized by the depiction of the face – eyes, nose, and typically, mouth – upper limbs, and the absence of engraving on the torso, as the stela itself substitutes for the body of the anthropomorph. Lower limbs are omitted, and no engraved elements appear beyond those that the anthropomorph may carry on itself – such as a diadem, necklace, and belt.

Type II (Fig. 8b) mirrors the previous type in facial engraving and the lack of torso depiction, with the upper limbs emerging directly from the area between the diadem and the necklace, and the lower limbs from the same place or from the necklace. Despite the significant similarities, it differs from the previous type because the support no longer replaces the human body. In addition to the elements that the anthropomorph wears – diadem and necklace – it lacks other engraved motifs.

Type III (Fig. 8c) shares with Types I and II the presence of a diadem and facial depiction. However, the engravers

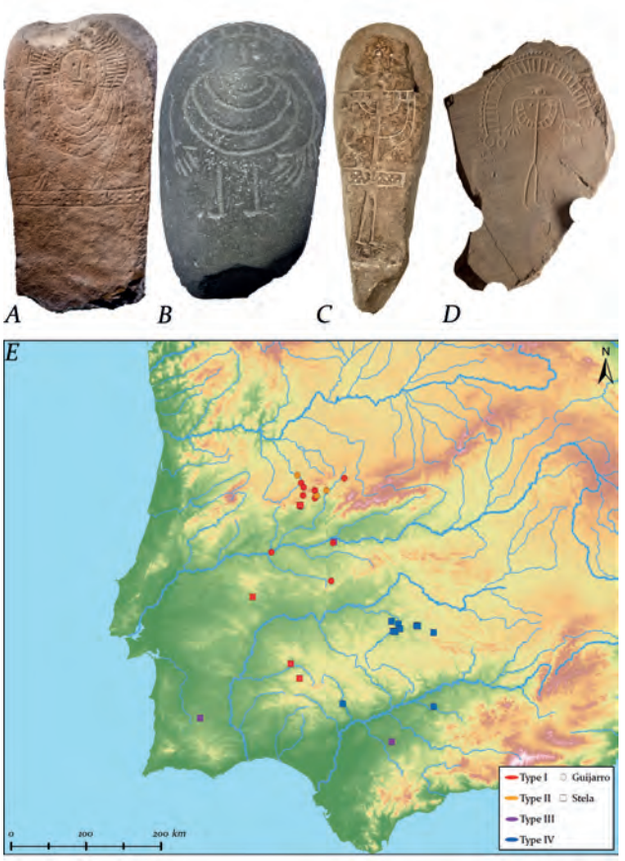

Figure 8. a) Example of Type I: Jerez de los Caballeros, Toriñuelo (h: 135 cm), b) Example of Type II: Ciudad Rodrigo (h: 40 cm), c) Example of Type III: La Lantejuela (h: 63 cm), and d) Example of Type IV: Capilla I. Different scales. (Photographs: Ángel. M. Felicísimo, KRAKEN Group). e) Distribution of diadem-stelae and "ídolos-guijarro" by Types.

did represent the figure's torso, including the lower limbs and, in some cases, other elements, as seen in the example from Torrejón el Rubio II.

Lastly, Type IV (Fig. 8d) encompass highly schematic depictions of anthropomorphs, with no facial features. The engraved individuals resemble warrior stelae, with arms, legs, and torso depicted through simple lines – often forming a 'T' shape for the chest, with arms extending from the ends of the horizontal line. Diadems may be either separate or attached to the head. Additional engraved motifs are common, and they appear alongside other anthropomorphic figures.

Upon correlating the type of support with the different categories, it becomes evident that all examples of Types III and IV are indeed stelae and are predominantly situated in the Guadiana and Guadalquivir valleys, except for Torrejón el Rubio II, which is located close to the Tagus River. Similarly, the Type I examples found in the Guadiana region (Jerez de los Caballeros-Toriñuelo, Bodonal de la Sierra, Arronches), as well as the specimen from Hernán Pérez 6, are also classified as stelae, without ruling out that some of the fragmented pieces from the Hernán Pérez group could belong to this category.

b. Swords

The sword is one of the most common items illustrated, present in 68% of the stelae and appearing in virtually all of those that are fully preserved. Unlike the other ubiquitous offensive weapon – the spear – the sword is wielded by the anthropomorph in nearly 30% of the representations. Unfortunately, due to the schematism, lack of skill, and ambiguity in many depictions, it is challenging to ascertain whether it was worn at the side or the waist. Approximately 45% of the representations suggest the former, while slightly over 55% suggest the latter. Moreover, although it is common to position the sword alongside the individual's hand, it is only occasionally brandished, as seen in exceptional cases like Utrera (Torre Alocaz).

An overview of the areas where the sword is carried in one way or another reveals that both occur in the Zújar basin, but while in the Tagus valley they are only documented at the side, the stelae from southern Portugal and the Guadalquivir valley only depict specimens with the sword at waist height (Fig. 9).

Regardless of its position, it seems that the common way of carrying swords was in a scabbard, as evidenced by depictions of swords and suspension elements on the stelae of Castrelo do Val and Tejeda de Tiétar. This practice of scabbard carrying, which persists into the pre-Roman period, is also noted in the Alentejo stelae from the Middle to Late Bronze Age, where swords are associated with a suspension element.

Figure 9. Swords carried at the side and at the waist.

c. Shields

Shields are perhaps the object that has generated most interest in research (Celestino 2001, with bibliography). The types shown on the stelae are essentially two: notched and circular.

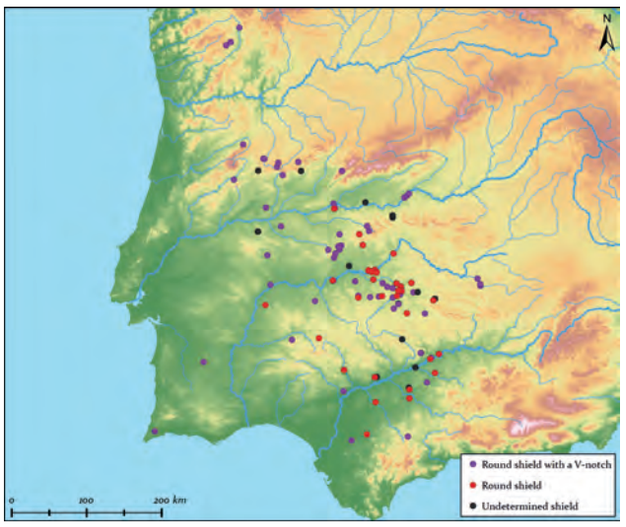

Figure 10. Distribution of stelae with shields.

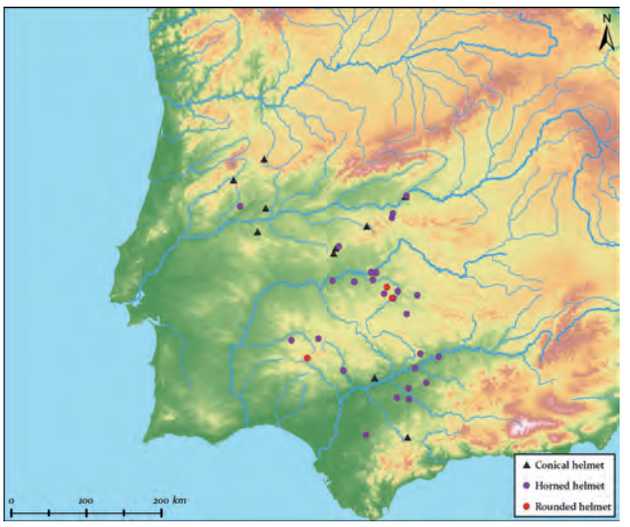

Figure 11. Distribution of stelae with helmets.

Regarding their distribution, circular shields are located in the valleys of the Guadiana and the Guadalquivir rivers, while notched ones are evenly distributed throughout the territory (Fig. 10).

d. Helmets

Helmets appear in over 25% of the stelae and can be divided into three types: conical, horned, and rounded/hemispherical (Fig. 11). Regarding the first two types, there seems to be no doubt about their representation on the stelae; however, the interpretation of the third type is more controversial. Assuming that diadems are characterized by being radiated, it could be argued that the semi-elliptical engravings on the heads of various anthropomorphs may represent rounded helmets. However, doubts may arise due to the absence of these rays in the secondary anthropomorphs presumed to wear a diadem on the stelae of Zarza-Capilla III and Córdoba-Ategua. Nevertheless, there is no question about the care that artisans took in engraving the diadems for main characters. Thus, we may perhaps identify hemispherical helmets on some of the stelae such as Cabeza del Buey I and the recently discovered stelae of Cañaveral de León I and III, which also bear armour. Likewise, it is possible that El Viso II, unfortunately lost, attempted to depict a helmet, as in Capilla III, although the dotted representation raises doubts as to whether they really intended to engrave a helmet. Some authors even consider that the helmets from Olivenza and Ibahernando II might be hemispherical helmets with feathers instead of horns (González Cordero *et al.* 2022, 69-71).

Depictions of conical helmets are concentrated in the Tagus basin, extending to the Douro basin. Some examples, such as those from Zarza de Montánchez or Fundão, exhibit details like rivets. This distribution is easily explained by their appearance mainly on Type A stelae. The exception would be two isolated specimens from Type B, characterized by their significant schematism, documented in the Guadalquivir River: Almargen and Lora del Río I-Setefilla. In both cases, there are two strokes at acute angles over the anthropomorph's head, preventing any formal classification of the helmet. We dismiss the possibility that the stela from Córdoba-Ategua had one of these helmets, as the line over the head appears more like a break than an engraving.

Horned helmets are the most common, particularly concentrated in the Zújar-Guadiana and Guadalquivir valleys, without extending to the Tagus basin except for Castelo Branco. This distribution is easily explained, as this type of helmet is only documented on Type B stelae, always appearing above the head of an anthropomorph, never detached.

e. Mirrors, Fibulae, and Combs

Mirrors (Celestino 2001, 163–169; Harrison 2004, 151–156) are, excluding weapons, the most depicted object in stelae, appearing in 45% of them. They are always rounded or oval-shaped and are found in all geographic areas (Fig. 12). For some authors, mirrors are the only artifacts of Mediterranean origin found on stelae (Brandherm 2013, 138).

In contrast, fibulae (Celestino 2001, 185–210; Mederos & Jiménez 2016) appear in just over 20% of stelae, primarily concentrated south of the Tagus River, with the exception of the Castelo Branco II-Sao Martinho II stela, to which we might add, albeit uncertainly, the one from Fundão (Fig. 13). Like the mirror, the fibula appears on stelae of Types A2 and B.

Regarding combs (Celestino, 2001: 163–169), their distribution is even more restricted and numerically less common, as they do not exceed 20%. This is an element

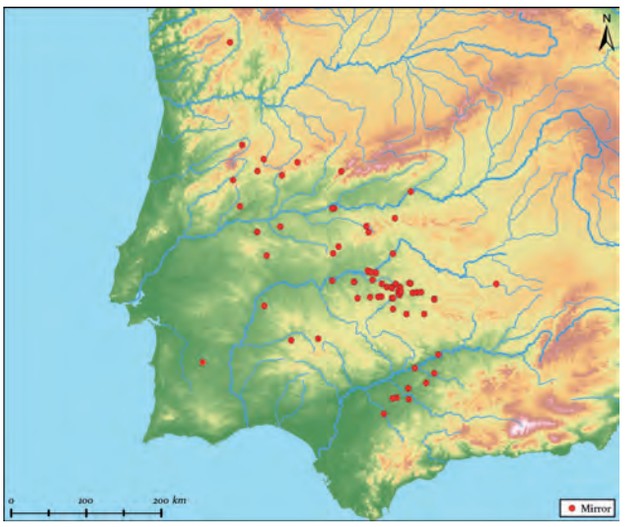

Figure 12. Distribution of stelae with mirrors.

Figure 13. Distribution of stelae with fibulae.

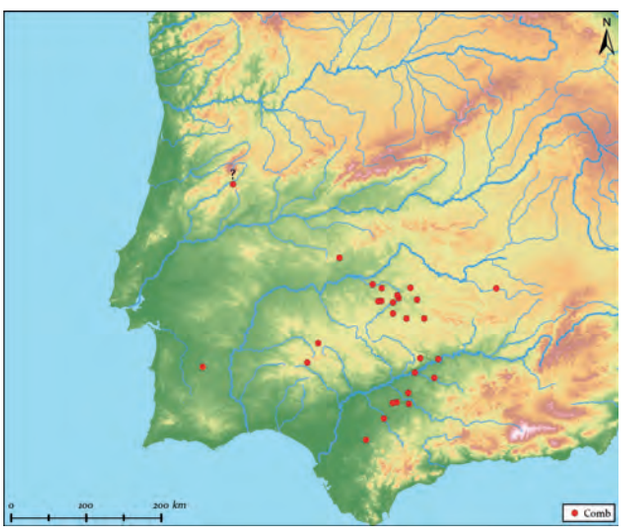

Figure 14. Distribution of stelae with combs.

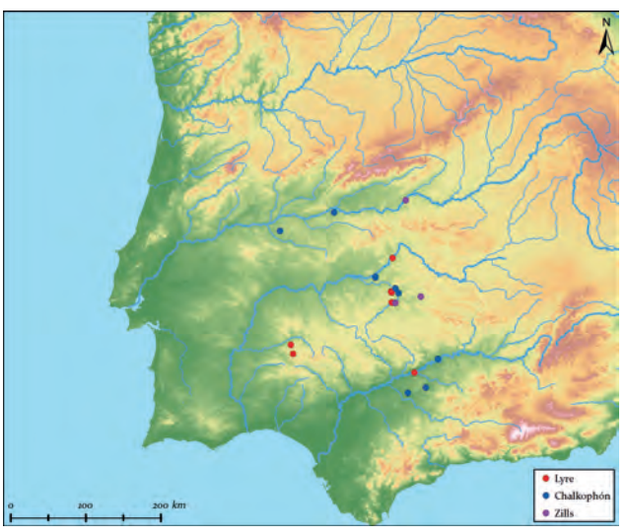

Figure 15. Distribution of stelae with musical instruments.

that appears exclusively on the most complex stelae in the Guadiana and the Guadalquivir valleys, as once again, the possible representation on the Fundão stela is highly problematic (Fig. 14).

f. Musical Instruments

Musical instruments are not commonly depicted on stelae, appearing in just over 10% of them. They can be divided into three categories: lyres (5%), chalkophones (5%), and crotales (2%) (Celestino 2001, 172–181; Adiego 2020). Although all of them are concentrated south of the Tagus River, their distribution is uneven. Thus, chalkophones are located in the Tagus, Guadiana, and Guadalquivir valleys, while crotales are only found in the Guadiana and the Tagus rivers. Lyres, on the other hand, are concentrated in the Guadiana River, with a single specimen in the middle valley of the Guadalquivir (Fig. 15).

Excluding the Luna stela, musical instruments are associated with Type B stelae, except for the Brozas specimen (A2), where a potential chalkophon has been depicted, although some scholars have interpreted it as a comb. This motif has been regarded as a later addition due to its distinct engraving technique (Celestino 2001, 339).

g. Series of Five Points

The series of five points is the most challenging recurring motif to decode. The most probable interpretation is that they are weights (Celestino 2001, 181–185; Vilaça 2011, 160 and 163), which must be related to weight-based transactions, with metal being the primary material in these exchanges (Ialongo *et al.* 2021, 6).

The presence of weights in a specific geographic area is a unique phenomenon among the depicted motifs (Fig. 16). The series of five points is located around the Zújar

Figure 16. Distribution of stelae with weights.

Figure 17. Distribution of stelae with hunting motives.

River, extending both eastward and westward from it. Outside of this group, only one of the missing stelae from Guadalcázar, in the Guadalquivir region, also displays them. We do not believe that this motif is present in the stelae of Fuente de Cantos or Olivenza, where a multitude of points are distributed throughout the compositional scene.

h. Hunting Motifs

Hunting-related motifs include the depiction of bows and arrows. The absence of the bow and arrow in the most basic stelae suggests that this weapon was not part of the warrior's panoply. On the contrary, their inclusion in those where power is represented in a more sophisticated manner supports their connection to hunting (Quesada 1997, 439; Celestino 2001, 160).

In half of the representations featuring the bow and arrow, another element appears alongside them. Amidst the typical variability in stelae depictions, the most common form resembles two circles joined by a thick line and a semicircle protruding from one side, interpreted as a quiver rather than an axe (Bendala 1986, 533) or a fibula (Harrison 2004, 161–162). The quiver would always consist of the depiction of the case and the strap used for hanging it, with the Écija III stela being particularly significant for this identification.

This interpretation of quivers with straps is supported by the swords from Castrelo do Val and Tejeda de Tiétar, where the sword carries a suspension element with significant parallels to those documented on quivers. This strip, allowing the quiver to be hung, could be decorated, as demonstrated by the Capilla VIII stela.

It is also common to associate a quadruped, possibly a dog, with this hunting-related symbolism, with the quadruped appearing alongside the bow and arrow in 36% of the stelae. It is noteworthy that in none of those from the Guadalquivir River do the bow and arrow appear alongside the possible dog.

The most significant example, which supports considering the bow and arrow as hunting weapons, is the stela of Castelo Branco II-São Martinho II, portraying a hunter taking aim at a deer pursued by a quadruped. In this case, the motif located to the left of the anthropomorph, between the quadruped and the fibula, could represent a quiver without the suspension strap.

Hunting weapons are illustrated in over 12% of the stelae, distributed across the basins of the Tagus, Guadiana, and Guadalquivir rivers. In the case of the Guadiana River, they are only found in the Zújar valley, being absent in the other tributaries. In this area, they consistently appear in combination with the quiver, except in the case of the fragmented and incomplete stela of Capilla IX (Fig. 17).

i. Chariots

The chariot motif has garnered significant interest due to its symbolic connotations and its potential implications for dating the stelae. All the chariots feature two wheels, with Solana de Cabañas being an exception where the engraver clearly made an error, depicting a second pair emerging from the pole. All the chariots are pulled by two animals, typically identified as horses, sometimes with their sex explicitly indicated.

This motif is present in over 22% of the stelae, which are particularly concentrated around the Zújar River, although they are distributed throughout the south of the Tagus valley, even extending beyond it. Its representation in Castrelo de Val – the most northern stela – stands out due to the gap existing between it and the rest of the set (Fig. 18).

Figure 18. Distribution of stelae with chariots.

Figure 19. Distribution of stelae with complex scenes.

Figure 20. Distribution of quartzite stelae.

j. Complex Scenes

Although practically anecdotal – as their count stands currently between 7 and 8 – stelae with complex scenes represent narrative discourses that, on many occasions, omit weapons in their composition. All of them are found south of the Guadiana River and represent the highest level of compositional sophistication documented in the stelae (Fig. 19).

While attempts have been made to associate the elements and human figures of the stelae with Tartessian religious beliefs (Tejera & Fernández 2012), perhaps the only stelae that allow us to approach this reality are the following. Several of them seem to narrate the journey to the afterlife of the protagonist, using the chariot for this purpose. This is the case with the stelae of Cabeza del Buey IV, Zarza Capilla III, Higuera la Real-Capote, and Córdoba-Ategua (Celestino & Paniego forthcoming), along with the questionable one from El Carpio – with the appearance of dancers being common in several of them – as well as in the Aldea del Rey III and Capilla XIII examples, where only dance scenes alone have been meticulously rendered to depict movement.

Lastly, the stela of Castelo Branco II-Sao Martinho II represents a hunting scene. It is the only known stela where the main anthropomorph portrayed is engaged in an activity, in this case, aiming at a deer located at the top of the scene, apparently harassed by a dog. This scene is quite distinctive and lacks parallels with the preceding ones or any other present on the known stelae.

3. Notes on the Chronology of the Stelae

a. Experimental Archaeology

In recent years, several experimentations have been conducted regarding the phenomenon of stelae (Gutiérrez *et al.* 2020; Díaz-Guardamino 2023), but of particular interest is the one carried out by the University of Fribourg within the project "The Iberian stelae of the Final Bronze Age: iconography, technology and the transfer of knowledge between the Atlantic and the Mediterranean". This research has highlighted the need for the use of hardened iron to engrave the quartzite stelae[4] (Araque *et al.* 2023), which account for about 20% of all known stelae, all of Type B and located in the Guadiana region (Fig. 20). The stelae of Torrejón el Rubio are characterized by very compact metagreywacke with a high content of quartzite (43–45%), raising the question of whether these extremely hard stelae of Type A2 also required, perhaps, the use of iron chisels for their production.

It is highly plausible that not only should the stelae be linked to the presence of iron tools, but also to the knowl-

[4] See Araque Gonzalez et al., this volumen.

edge of iron metallurgy, which arrived in the Iberian Peninsula during the 9th–8th centuries BC, as evidenced in Huelva, Acinipo (Ronda, Málaga), and Morro de Mezquitilla (Vélez-Málaga, Málaga) (Gomá 2018, 354; Becerra 2023, 211), providing us with a *post quem* date for the carving of the stelae.

b. The Relationship with Writing

The Southwestern or Tartessian writing system (de Hoz 2023, with bibliography) is found across a wide territory of the southwestern Iberian Peninsula (Fig. 21d), though concentrated in the Portuguese regions of Baixo Alentejo and Algarve and has been dated to between the 7th and 5th centuries BC (Rodríguez Ramos 2015, 128; Correa & Guerra 2019, 125-126).

Although it has been commonly assumed that the writing on warrior stelae (Fig. 21b and 21c) is a later addition (Celestino 2001, 441; Brandherm 2013, 141), the respect for previous engravings and the fact that the same phenomenon, albeit in reverse, where a warrior – with his own characteristics – is depicted on a stela with writing (Fig. 21a), suggest that it is in fact a contemporary phenomenon.

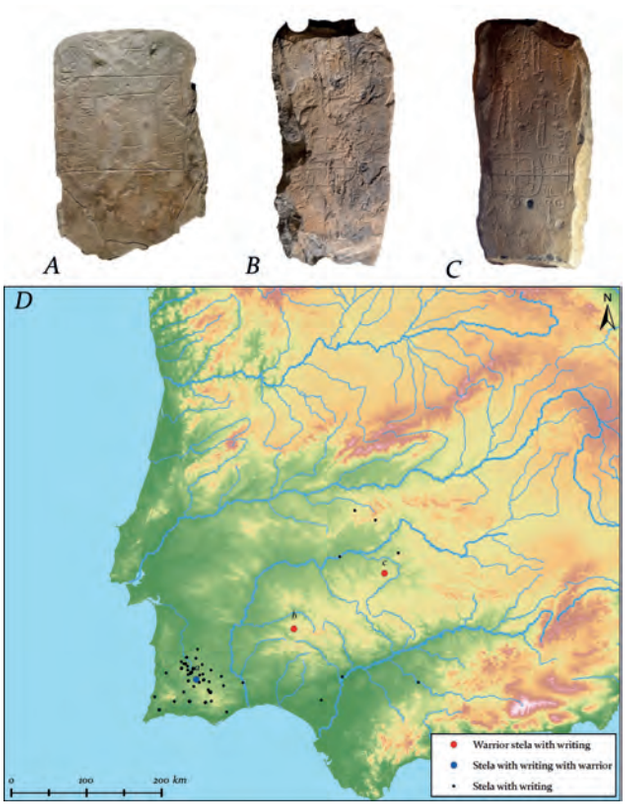

Figure 21. a) Almodôvar. Gomes Aires (h: 90 cm) b) Cabeza del Buey IV (h: 120 cm) c) Higuera la Real. Capote (h: 95 cm). Different scales. (Photographs: Ángel. M. Felicísimo, KRAKEN Group) d) Distribution of stelae with writing.

c. Dating the Stelae through the Depicted Objects

Inferring the chronology of the stelae from the depicted elements poses a highly challenging task given the schematism and lack of detail in the representations, not to mention the common occurrence of a broad chronological span in the use of those objects. It is also not uncommon for the suggested chronologies for the objects on the same stela to differ, often favouring the more recent one, unless we interpret that the stelae were regularly reused and reinterpreted. The latter scenario does not appear to be common, although there are examples where it must have occurred, such as in Zarza-Capilla I or Esparragosa de Lares I, where certain motifs are intentionally erased, or in Brozas, where it has been suggested that a possible musical instrument was later included.

Despite this, the virtual absence of alternative dating methods makes it necessary to tentatively approach this issue.

Concerning the swords depicted on the stelae, with few exceptions, they exhibit minimal detail, making it challenging to categorize them within any known sword typologies, despite serious attempts to do so (Brandherm 2007, 134–155). The leaf-shaped and carp-tongue types are clearly documented in Alamillo, Aldeanueva de San Bartolomé I, Cabeza del Buey II, Ibahernando I, Solana de Cabañas, or Torrejón el Rubio III, for example, including types E, F, G, and H by Brandherm. However, this scholar acknowledges that the schematism of the representations makes it difficult to match the types of the stelae with those known in the archaeological record (Brandherm 2007, 143). While the identifiable forms belong to swords typical of the Bronze Age, some types continued to be used in the Iron Age, as evidenced by the mould from Ronda from the 7th century BC (del Amo 1983, 92). Farnié and Quesada (2005, 42–43) have suggested that Atlantic Late Bronze Age types disappear throughout this century, matching the appearance of iron swords. We must also not forget that some of the oldest iron swords perpetuated the known bronze forms (Farnié & Quesada 2005, 216). The scarce number of iron sword specimens in the western Iberian Peninsula during the Iron Age (cf. Farnié & Quesada 2005) invites us to consider the possible continuation of bronze weapons beyond the 7th century BC. This is the case of bronze spearheads, which, although rare, continue to appear in the archaeological record, with examples in the necropolis of Olival do Senhor dos Mártires (Alcácer do Sal, Alentejo) (Gomes 2021, 262) or in Cancho Roano (Zalamea de la Serena, Badajoz) (Celestino & Jiménez 1993, 112), not to mention Strabo's remark (III, 3, 6) about their use among the Lusitanians several centuries later.

The Chillón III stela, on the other hand, appears to depict a "frontón" sword. Examples of this type, of Italic origin, have been documented from the 8th century BC in the

Iberian Peninsula. This type of sword had limited distribution until the emergence of indigenous varieties during the Late Iron Age (Quesada 1997, 180–181).

The shields depicted on the stelae are divided into notched and circular types. The former would have been made from perishable materials such as wood and leather. They can be reasonably associated with the Herzsprung type (Uckelmann 2012, 127–137). These have a broad chronology between the 11th and 9th centuries BC (Uckelmann 2012, 61–62), and the votive examples from the 8th century BC documented in the Mediterranean and the Iberian Peninsula (Harrison 2004, 133–134; Uckelmann 2012, 167) confirm that they continued to be used in this century. Thus, nothing prevents us from suggesting that they continued to be used afterwards, at least on the Iberian Atlantic coast. The circular shields possibly were also made of wood, as evidenced by those depicted in Torrejón el Rubio III. The widespread use of large round wooden shields on the Peninsula would occur in the 6th century BC (Quesada 1997, 545–546). Unfortunately, their simplicity makes it difficult to classify them into any specific type (Brandherm 2013, 136).

While there is a certain prevalence of notched shields in the basic stela types and circular shields in the complexes, the appearance of circular shields in Type A1 stelae and notched shields in some of the more complex ones prevents drawing conclusions about the chronology of the stelae based on this element or their possible evolution from one type to another.

The helmets shown on the stelae can be divided into three groups: conical, horned, and circular. The conical helmets have been considered the oldest, dating back to the mid-late 2nd millennium BC, although more recent dates ranging up to the 10th–9th centuries BC have also been suggested (cf. Mederos 2019, with bibliography), which would better align with the deposit in the Huelva estuary, the only site in the Iberian Peninsula where they have been undoubtedly identified.

Regarding the dating of horned helmets, it is challenging to define precisely due to their wide-ranging chronology. For instance, in Sardinia, their use spans from the 12th to the 8th century BC, while in Scandinavia, it ranges from the 11th/10th to the 8th century BC. It has been suggested that they may have arrived in the Iberian Peninsula, possibly via Sardinia, as early as the 12th century BC (Vandkilde *et al.* 2022: 152). As for the material record, horned helmets are notably absent from the region where the stelae are found. However, in Asturias (northern Iberian Peninsula), examples of horned helmets dated between the 8th and 5th centuries BC have been recovered[5] (Villa & de Blas 2021).

Establishing the chronological boundaries of the potential rounded helmets poses an even greater challenge. As a hypothesis, it could be proposed that they may be trying to represent Greek helmets akin to those found in the southern Iberian Peninsula, dating back to the 7th–6th centuries BC (Quesada 1997, 551).

Weights can be used as a *terminus post quem*, as the oldest examples in the Iberian Peninsula date back no further than the 11th–10th centuries BC (Vilaça, 2011).

Concerning the chronology of chariots, theories diverge: some hypotheses advocate for ancient dates (14th–12th centuries BC), while others defend more recent ones (between 900 and 500 BC, extending to 300 BC) (Mederos 2008, with bibliography). Furthermore, there are also discrepancies between those who argue that the chariot (like other objects) was not seen by the individuals who carved them (Galán 1993, 52 and 75–76; Celestino 2001, 231) and those who believe that the represented objects did indeed reach the Iberian Peninsula. Although the fact that many chariots are depicted schematically or even inaccurately, as seen in Solana de Cabañas, might align with the theory suggesting that chariots had not been previously seen, we believe that the details present in some representations, such as the yoke saddle in Cabeza del Buey IV, indicate the opposite (Quesada 2005, 47). In fact, remains of chariot have been documented in the necropolis of La Joya (Huelva) (Garrido & Orta 1978, 63–81 and 128) and Olival do Senhor dos Mártires (Alcácer do Sal, Alentejo), dated between the second half of the 6th century and the first half of the 5th century BC (Gomes 2021, 311), as well as decontextualized pieces in other areas of the southern Iberian Peninsula (Ferrer & Mancebo 1991). Quesada (2005, 47) has argued that those depicted on the stelae are Aegean-type war chariots, and although they could be older, it seems likely that they should be dated between the 9th and 7th centuries BC. Thus, they should not be related to the aforementioned slightly later specimens. Once again, certainties are scarce, and the possible chronological range makes using the chariot as the main indicator for dating the stelae risky.

The absence of the portrayed elements in archaeological contexts is a consistent pattern, so much so that we might question whether the pictograms on the stelae should not be interpreted as substitutes for the real pieces, as many of the objects would be too valuable to be discarded (Perea 1991, 125). In the case of weapons and metal ornaments, they could either remain in use or be melted down, a phenomenon that would contribute to the scarcity of these elements in archaeological contexts, ultimately complicating dating the stelae based on their presence. Considering the stelae as a kind of substitute offering does not necessarily imply, as previously mentioned, that real objects did not

[5] 2460 ± 30 BP (95,4% probability): (60,5%) 671–453 cal BC, (29,2%) 757–679 cal BC, (5,7%) 446–416 cal BC (Villa & de Blas 2021, 304).

circulate or that the craftsmen who engraved the stelae were unfamiliar with them first-hand.

d. Stelae from the Iron Age?

The notion that stelae are exclusively associated with the Late Bronze Age seems not to be supported by the latest data. While it is true that the simplest stelae, those of Type A1, might have been carved during that period, possibly being the only ones preceding the 9th–8th centuries BC, they may not be much older, or they even could date back to the Iron Age. Stelae of Types A2 and B, on the other hand, appear to be characteristic of the Early Iron Age along the Atlantic facade of the Iberian Peninsula.

Supporting this chronology are the aforementioned experimental studies, the new approach to interpreting the stelae with writing, some of the depicted objects, and the scarcity of primary archaeological contexts in which they have been found, such as the necropolis of Setefilla (Seville) (Aubet 1997) and Las Capellanías (Cañaveral de León, Huelva) (Rivera *et al.* 2021), where ongoing excavations seem crucial not only to define the chronology of the stelae but also their functionality.

The most challenging aspect to justify the argument that Types A2 and B were not contemporaneous is explaining why, in general terms, stela production ceased among the communities north of the Tagus River at the same time that it began in the southern regions, since we lack any data supporting some sort of population movement that could explain this phenomenon.

In light of this, although the issue remains open and many questions still linger, the data suggests that the bulk of the phenomenon is concentrated in the Iron Age, between the 9th–8th centuries BC and the 7th–6th centuries BC. There may be some evolution in the depicted motifs between the oldest and most recent examples, even within the same types, which would explain the presence or absence of, for instance, conical helmets in Type A2 stelae.

4. The Society of Stelae

The society that carved the stelae is undoubtedly a chiefdom society. The specific type remains to be defined, although it is possible, and even probable, that different types exist within the extensive area encompassed by the stelae. Even if the hypothesis that Type A1 stelae are older is correct, one might wonder whether there was any kind of change in the model of social organization that was mirrored in the change in iconography.

For other regions, such as the Central Mediterranean, it has been proposed that warrior chiefs were granted authority during wartime but not in times of peace (Araque 2023, 10), similar to the chiefs studied by Clastres (2010, 220). These nominal chiefs lack real power, unlike the strong chiefs (Lowie 1979, 114–120) found in complex chiefdoms, where rank differences have transformed into class divisions (González Wagner 2006, 186; Wolf 2022, 139). The authority of chiefs, understood as legitimized power (Cohen 1979, 34), is based on a combination of coercion and ideology (Harris 1993, 45). The latter implies the direct linkage of the chieftaincy authority with religious, economic, and political control, which, we believe, can be traced in the iconography of the stelae (Harrison 2004, 67–80).

The Type A1 stelae exclusively depict coercive-military power. If indeed these were the earliest and the genesis of the phenomenon, one might inquire whether they still reflect a simple chiefdom with minimal social stratification, wherein the represented element is the chieftaincy itself. However, for Type A2 and B stelae, the emergence of prestigious goods appears to indicate a markedly unequal system. In these goods through which chiefs (or lineages) self-represent on the stelae, ritual value outweighs utility (González-Wagner 2006, 187), indicating the prominence of social status as a marker, hence their depiction in the engravings.

Chariots would be an example of this. There is a certain consensus in considering them an element intimately related to the elites, and some scholars even suggest that the presence or absence of chariots would represent the social differences between the aristocrats and the vassals of the communities depicted on the stelae (Alarcão 2001, 325–333). While this theory could be upheld for communities located south of the Tagus River, its near absence to the north seems to invalidate such a thesis. Instead, it does not seem unreasonable to think that we are dealing with groups representing power in a different manner.

Without delving into the process of social division and its representation, it is nonetheless crucial to emphasize that the elites depicted on the stelae acquire their power through economic control, not so much by controlling the means of production but rather by appropriating the labour of others, facilitated by economic exchange with the colonizers and the core of Tartessos (González Wagner 2006, 192–193; Wolf 2022, 120–123). It is through the control of this unequal exchange that these luxury goods are acquired, enabling dominant groups to assert their superiority (Wolf 2022, 125). Furthermore, the exchange itself and its monopoly are also objects of prestige and merit representation on the stelae through the inclusion of items such as weights. Although the use of weighing technology is not necessarily associated with central power, as it is a system largely used, controlled, and regulated by private agents (Ialongo *et al.* 2021), we believe its inclusion on the

stelae should be linked to this control of trade, possibly in metal, by the elites depicted on the stelae, who acted as intermediaries with the Phoenicians and the core of Tartessos (Celestino 2023, 35–36). Undoubtedly, the concentration of this motif in a specific geographical region underscores the importance that economic-commercial control by its elites assumed in this area, as well as a common discourse among regional chieftaincies on how control of trade reinforced their legitimacy.

The horned helmets, which are the only weapons documented on some of the complex stelae, such as Cabeza del Buey IV, deserve special mention, thus their importance must be considered from perspectives not tied to the military sphere. Despite hypotheses suggesting that the motif of the anthropomorph with horned helmet should be understood as a common symbol of the traveller in Europe and the Mediterranean related to hospitality and intergroup relations (Araque 2023), we believe it is more likely to relate this pictogram to the religious sphere. This symbol is often associated with divinity, both in the Mediterranean and in northern Europe (Kristiansen & Larsson 2006, 370; Tejera & Fernández 2012, 98–99; Vandkilde *et al.* 2022, 152). This prompts the question of whether what the stelae represent implies the deification of the leader himself or only his special relationship with divinity, elucidating one aspect of leadership: its function as a conduit for contact with the divine. This intimate connection with the religious realm raises the dilemma of who is divine: the leader or the chieftaincy (cf. Evans-Pritchard 1979). Thus, in addition to the possession and hoarding of prestige goods, the monopoly of trade, and the maintenance of coercive power, many of the stelae demonstrate religious control as a source of legitimacy.

Ultimately, the three defined types reflect varying forms of power (self)representation, and the greater complexity of Type B could indicate how in societies that engraved these stelae, the authority of the chieftaincy begins to parallel that of the individual who holds power, rather than solely with that of the chieftaincy as an abstract representation of the prevailing social order.

Given this, the undeniable connection of the stelae with the protohistoric Iberian chiefdoms opens the door to defining these stelae not so much as warrior stelae but as chieftaincy stelae, as the warrior is merely one of the forms of (self)representation of the chief.

5. Discussion and Conclusions

The stelae constitute an inland phenomenon along the Atlantic facade of the Iberian Peninsula, as those found near the sea are anecdotal. Additionally, their complete absence in what was the core of Tartessos is notable, an argument wielded to associate them with the surrounding societies that supplied goods and perhaps labour to the Tartessian and eastern communities of the southern Iberian Peninsula.

Once the stelae are classified, it becomes evident that their distribution in the inland areas of the Atlantic facade is uneven. In the case of Type A stelae, characterized by the absence of the anthropomorph or its secondary role in representation, we see how they are concentrated north of the Guadiana River, with their presence being particularly intense in the Tagus-Duero interfluve and the Cáceres region of Montánchez-Trujillo. That said, Type A stelae are also found in the Guadiana, the Jabalón (a tributary of the Guadiana), and the Guadalquivir rivers.

If we examine the distribution of Type A1 stelae to speculate about the origin of the phenomenon, we find that the hypothesis suggesting their emergence in the Portuguese Beira and the northwest of Spanish Extremadura (Celestino & Salgado 2011: 437) does not seem to hold, although it is true that the highest concentration is found in the inner Beira and the Montánchez-Trujillo area. Regarding the chronological aspect, it is not unreasonable to suggest that these Type A1 stelae might have been slightly older than the rest, although we believe that if this were the case, they should not have been much older.

The presence of imported elements in Type A2 stelae, associated with the display of non-coercive power, leads us to consider that both these and the more complex ones (Type B) belong to the Early Iron Age, a period during which contact with Tartessos and eastern settlers would have brought about the arrival of these prestige goods. The uneven distribution of both groups could be explained by the type of chiefs leading them and how they (self)represent their power. However, in both cases, they would already be complex and stable chiefdoms different from those characterized by the existence of nominal chiefs. This idea is supported by the fact that except in very specific points, A2 and B stelae complement each other in their distribution, both potentially inheriting from older specimens, namely Type A1, where it is worth asking whether the chiefs represented also wielded power beyond warfare and whether this involved extracting surplus value from other social classes.

This uneven distribution of types does seem to follow a pattern, thus challenging the thesis proposed by Barceló (1992, 268–269), which denied the existence of clusters of stelae that would allow for the creation of chronological[6] or geographical groups. We believe that, in general terms, his thesis, followed and expanded upon by Alarcão (2001, 325–333), which argues that compositional differences stem from social disparities, is not valid.

[6] This scholar, however, does argue that the basic stelae may indeed be older (Barceló 1992, 269).

However, if we analyse this theory at a micro level, it could make sense and explain the variabilities within a specific territory. As mentioned earlier, our proposal regarding the differences between A2 and B arises from the type of chieftaincy and how they (self)represented their power. In Type B stelae, chieftaincies are already being personified and individualized, masking power under new attributes of domination subtler than mere coercive power. Within this representation of more sophisticated power is where we must place the economic-commercial control represented by the weights, the control of imported prestige goods, the engagement in activities restricted to the elite such as big game hunting, religious control, and perhaps the deification of chiefs represented in horned helmets, or the existence of myths depicted in the transition to the afterlife.

The absence of certain items on the northern stelae, such as weights, musical instruments, or combs, might contradict this proposal. Yet, the presence of other elements like chariots, mirrors, or even circular shields, would argue for contemporaneity. It is important to understand that we should date the stelae by the most recent elements rather than the oldest ones, given that many of these objects were used over wide temporal spans, as is the case with Bronze Age swords, whose form is known to persist into the early iron swords, with their use likely extending until at least the 7th century BC.

Accepting these premises, it is possible to propose as a working hypothesis the slightly earlier dating of Type A1 stelae, perhaps in a transitional period between the Late Bronze Age and the Early Iron Age, but likely never before the 10th century BC. Type A2 and B stelae, therefore, would be characteristic of the Early Iron Age, with their origin between the 9th and 8th centuries BC and their end between the 7th and 6th centuries BC.

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CHAPTER 4

‘Ídolos-guijarro’ and ‘Diademada-stelae’: chronology and context of anthropomorphic representations with ‘diadems’ or headdresses

Vera Rammelkammer

Abstract

Stelae with depictions of persons wearing headdresses are a well-known phenomenon in Iberian prehistory and a variety of typologies and hypotheses have been proposed for their analysis. Despite this, there is still no clarity on their chronology, which especially applies to the so-called *ídolos-guijarro*, which are often considered older than other diadem stelae from the Late Bronze Age (c. 1200-800 BC). This contribution provides a general overview including a short description and definition of both, the diadem stelae and the *ídolos-guijarro*, and assesses the current state of research, the typology, and especially the chronology of these groups. Moreover, their contexts and inter-relations are being discussed, with a focus on the presumed connections to chalcolithic iconography and megalithic structures. The aim is a critical approach towards those observations. It will be emphasized that stelae and megalithic structures are not necessarily contemporaneous, even though it is remarkable that some sites where stelae and idols have been found indicate a long term use over several periods. Finally, the latest findings and perspectives for future research are briefly discussed.

Keywords: Diademada-stelae; stelae with headdress; ídolos-estelas; estelas guijarro; estelas seixos; Hurdes Gata group; chronology; typology.

Resumen

Las estelas con representaciones de personajes tocados son un fenómeno bien conocido en la prehistoria ibérica y se han propuesto diversas tipologías e hipótesis para su análisis. A pesar de ello, todavía no hay claridad sobre su cronología, lo que se aplica especialmente a los llamados *ídolos-guijarro*, que a menudo se consideran más antiguos que otras estelas con diadema de la Edad del Bronce Final (c. 1200-800 a.C.). Esta contribución ofrece una visión general que incluye una breve descripción y definición tanto de las estelas diademadas como de los *ídolos-guijarro*, y evalúa el estado actual de la investigación, la tipología y, especialmente, la cronología de estos grupos. Además, se discuten sus contextos e interrelaciones, con especial atención a las presuntas conexiones con la iconografía calcolítica y las estructuras megalíticas. El objetivo es un enfoque crítico de estas observaciones. Se hará hincapié en que las estelas y las estructuras megalíticas no son necesariamente contemporáneas, aunque es destacable que algunos yacimientos en los que se han encontrado estelas e ídolos indican un uso prolongado a lo largo de varios periodos. Por último, se discuten brevemente los últimos hallazgos y las perspectivas para futuras investigaciones.

Palabras clave: Estelas Diademadas; estelas con tocado; ídolos-estelas; estelas guijarro; estelas seixos; grupo de Hurdes Gata; chronologia; tipologia.

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1. Introduction

The Iberian Stelae and their representations of human figures have been extensively studied (Araque Gonzalez 2018; Celestino Pérez 2001; Díaz-Guardamino 2010). Throughout decades of research, numerous groups, types and subtypes have been established based on their regional distribution, form and iconography. One group requires a closer examination: the *diademada*-stelae (or *estelas con tocado;* Díaz-Guardamino 2010) and, amongst them, the so called *ídolos-guijarro* or *ídolos estelas* (Almagro Basch 1972), also known as *estelas guijarros*[1], *estelas/ídolos seixos* or Hurdes Gata-group (Almagro Gorbea 1977, 194-201; Bueno Ramírez 1987; Correia 2010; Sevillano San José 1991). This group, which I will refer to as *ídolos-guijarro* in the following, can be defined as stones with anthropomorphic decoration, engraved in rounded river rocks. What they all have in common is the representation of some kind of headdress, in many cases interpreted (or at least referred to) as a diadem. Since they first had been discovered, many studies tried to categorize the finds and examined them under formal and iconographic as well as geographical and socio-cultural aspects (e.g. Almagro Basch 1972; Almagro Gorbea 1977, 1991, 1993, 1994; Araque Gonzalez 2018; Breuil 1920; Celestino Pérez 2001; Díaz-Guardamino 2010; Galán Domingo 1993; Paniego Díaz this volume; Ruíz-Gálvez Priego and Galán Domingo 1991). Especially in the more recent contributions (Bueno Ramírez 1981, 47-49 and 1984, 605-618; Barceló 1988, 1991; Correia 2010; Santos 2009, 2010; Sevillano San José 1991), their chronology is discussed, however their exact chronological classification remains unclear until today. The controversial assumption persists that the *ídolos-guijarro* must be significantly older than all other *diademada*-stelae, which are seemingly situated in Late Bronze Age (LBA) contexts, and this is frequently debated. The aim of this paper is to provide a definition and short description of the abovementioned groups with regards to their typology and to give an overview of the current state of research. Moreover, their contexts and relations with other rock art monuments, and especially their chronology will be discussed. Finally, there will be an outlook on new findings and perspectives for future research. The stelae with depictions of figures wearing specific headdresses are part of an outstanding symbolic complex among the Iberian stelae and their study within this project aims to achieve a better understanding of the stelae's role as a means of communication in Iberian prehistory.

2. Overview: *Ídolos-guijarro* and *Diademada*-stelae

Diademada-stelae can be defined as the group of anthropomorphic representations that seem to wear a diadem or some kind of headdress (Santos 2010, 49). The semi-circular motif is located above the face, supposedly indicating that it was worn on the head, and consists of rectangular compartments forming a lattice structure. The latter can range from one to three lines, but specimens with two lines occur most frequent. On the lateral extremities, sometimes circular or subtriangular end pieces can be observed (Santos 2010, 50). In some cases, rows of dots appear along the upper edge of the adornment (e.g. Capilla I, Arrocerezo/Caminomorisco, El Bardal/Robledillo de Gata, Zebros I). This whole complex of elements also has been referred to as veil ("*manto*", Sevillano San José 1991, 99). Its purpose is unknown, however some researchers speak of a "ritual diadem" (e.g. Sevillano San José 1991, 103), although we cannot know in what kind of rituals they might have been worn and what they could have meant in these contexts. Moreover, no exact material counterparts of such objects have been found in the Iberian Peninsula (for more see 3. Context and relations).[2]

The so-called *ídolos-guijarro* similarly depict anthropomorphic figures with diadems in a relatively homogenous way (Fig. 1). However, they were made with rather small, rounded river rocks instead of large, hewn monoliths, and are often referred to as "*ídoliforme*"/"*con caracter de ídolo*". In addition to face and limbs, motifs such as necklaces ("*collares*"), belts and, in a few cases, possible weapons can be identified. Unlike other stelae, *ídolos* were probably not erected vertically, at least there exist no traces that indicate that they were embedded into the ground for this purpose (pers. Comm. Ralph Araque Gonzalez).

Concerning their regional distribution, the finds of *ídolos-guijarro* spread across the North of the province of Cáceres (Sierra de Gata) and the southern part of the province Salamanca (Celestino Pérez 2001, 239-242; Correia 2010, 55; Sevillano San José 1991, 100). In terms of their regional and geomorphological contexts, the vicinity to natural communication routes is noteworthy (Santos 2009, 26): e.g. the stelae from Hernán Pérez and El Bardal/Robledillo de Gata have been found along a preferential access route to the interior of the Serra de Gata, from the plateaus of the Lower Meseta (Correia 2010, 66). M. C. Sevillano San José also emphasizes the North-South distribution of the finds along an important route, called "*Camino de la*

[1] "Guijarro" could be translated as pebble or riverstone, rounded due to the action of running water. However, in this specific archaeological context its dimensions are larger than the geological grain size of a pebble.

[2] In some cases, a semi-circular motif above the head could also be interpreted as a helmet (e.g. Cañaveral de Leon I). Paniego Díaz this volume.

Fig. 1: Ídolos-guijarro: A: El Bardal/Robledillo de Gata (height: 80 cm); B: Cerezal/Nuñomoral (height: 60 cm); C: Galavís/Alcantará (height: 88 cm); D: Arrocerezo/Caminomorisco (height: 55 cm); unscaled (after González Bornay 2021, 11, 41, 57, 38).

Plata"[3] (Sevillano San José 1991, 100, 113) and points out a possible connection to local mining activities (Cardoso 2011, 103; Sevillano San José 1991, 100). Most *ídolos-guijarro* were most likely made from locally available rocks (Correia 2010, 59-61). Currently, precise petrological analyses are not yet available for all stelae, but various local rock types that have been used have been determined macroscopically: diabase (Cambrocino/Caminomorisco, Agallas[4]), black basalt (Ciudad Rodrigo I, Hernán Pérez IV), granite (Hernán Pérez II, V, VI, VII), sandstone (Ciudad Rodrigo II), schist (Agallas, Hernán Pérez I), limestone (Hernán Pérez III) and greywacke (Riomalo de Abajo/Caminomorisco, Arrocerezo/Caminomorisco) (Correia 2010, 59-61; see Ferreiro Mählmann *et al.*, this volume). The heterogeneity of the blocks with regard to their rock types and colours, with a perceived tendency towards rather dark rocks, is remarkable (Correia 2010, 60). Their dimensions vary between slightly over 1,00 m in height (Ciudad Rodrigo II, Agallas) to fragments of just under 0,40 m (Hernán Pérez VII, Riomalo de Abajo/Caminomorisco), the majority measuring an average of ca. 0,60 m (for exact dimensions, see Correia 2010). However, it is necessary to take into account their state of conservation, since many stelae have been broken or damaged, so that in some cases it is no longer possible to assess their original dimensions. As mentioned above, the *ídolos-guijarro* are generally smaller than other stelae. The motifs were engraved into the rock resulting in well-defined lines that are still easily recognisable (Fig. 2).

There are different interpretations concerning their function and meaning, reaching from possible contexts as

Fig. 2: Ídolo-guijarro from Riomalo de Abajo/Caminomorisco (height: 39 cm), unscaled (Barroso Gutiérrez 2015).

female deities, heroes or ancestors to representations of individuals with a special role in society (e.g. ritual contexts, warriors, members of an elite). For a number of reasons, most of the depicted figures are considered to be females (Almagro Gorbea 1994, 90-91; Celestino Pérez 2001, 256; Díaz-Guardamino 2010, 28; Zarzalejos Prieto, Esteban Borrajo and Hevia Gómez 2011, 400-426), even though not all representations show clear sexual characteristics. For example, the representations on the idol from Salvat-

[3] Connecting Gijón and Oviedo in the North and Seville in the South (Sevillano San José 1991, 100).
[4] For Agallas there is divergent information: diabase (Sevillano San José 1991, 109) or schist (Correia 2010, 60).

Fig. 3: Stela from Negrões/Castro Verde (after Pablo Paniego Díaz/Ángel Felicísimo, Grupo KRAKEN).

ierra de Santiago and the Negrões/Castro Verde (Fig. 3) stela are most likely to be interpreted as women, due to the depiction of breasts.

The same can be stated for the *diademada*-stelae of Capilla I and Belalcázar I (Berrocal-Rangel 1987, 92). M. Zarzalejos Prieto, G. Esteban Borrajo and P. Hevia Gómez, however, pointed out that there is not only a considerable amount of stelae with possible depictions of breasts, but also that the assignment of gender based on certain attributes is very complex and still heavily influenced by common stereotypes about gender roles (Zarzalejos Prieto, Esteban Borrajo and Hevia Gómez 2011, 402-406; see also Santos this volume; for a more supra-regional approach on gender in iconography see Araque Gonzalez 2018, 340-341). Hence, headdresses and necklaces are usually interpreted as feminine attributes whereas any kind of weapons are thought to be masculine characteristics (Celestino Pérez 2001, 254-260). In this sense, P. Bueno Ramírez, R. de Balbín Behrmann and R. M. Barroso Bermejo have put forward the theory that depictions of weapons (specifically the halberd thought to be visible on the stela of Hernán Pérez VI, Fig. 4) would in these particular cases represent a male warrior (Bueno Ramírez, Balbín Behrmann and Barroso Bermejo 2005, 21-22, 32; 2008, 57; Galán Domingo 1993, 42, 75; see Díaz Guardamino 2010, 28).

R. J. Harrison, on the other hand, suggested that figures with diadems were male heroes who wore headdresses as part of a ceremonial costume. He assessed that women were not represented in LBA Iberian iconography at all (Harrison 2004, 261-278; for criticism see Araque Gonzalez 2018, 245-246). Especially in the light of new finds

Fig. 4: Stela from Hernán Pérez VI (after Tortosa et al. 2021, 13).

such as the Negrões/Castro Verde stela this seems not very likely. One find with an exceptional depiction of a possible primary sexual characteristic is the *ídolo* from A-da-Moura (Santana da Azinha, Guarda). The near-oval motif is located in the middle lower part of the stela and consists of two vertical convex lines and two small holes[5] that seem to be connected by another vertical line. This has been interpreted as a phallic symbol by some researchers (da Silva 2000, 233; pers. Comm. Pablo Paniego Díaz) and as a female genital by others (Santos 2010, 46-49). Thus, the motif itself remains inconclusive and leaves room for both interpretations. Unfortunately, it is now hardly visible due to weathering and the existing interpretative drawings can be misleading because they make an unprejudiced attribution even more difficult.

Even if no clear conclusions can be drawn from iconography alone, much of the archaeological evidence indicates that women have had a high social status that might

[5] However, it is not clear whether these are intentional (Santos 2010, 46-47).

as well have been connected to female concepts in religious beliefs and the role of women in rituals or ceremonies (Zarzalejos Prieto, Esteban Borrajo and Hevia Gómez 2011, 403; Berrocal-Rangel 1987, 91-92).

Since their first discovery, various attempts have been made to categorise the monuments typologically, not all of which can be presented here in detail. Terminology and typology both have been intensively debated as they are closely linked to the problem of the chronological context of the finds.

At the time, M. Almagro Gorbea defined a total of three main types of anthropomorphic stelae, encompassing four subtypes (Almagro Gorbea 1994, 71). For the study of *diademada*-stelae, his type B "representaciones de figuras femininas" (representations of female figures) is most relevant: "estelas-menhir con representaciones idoliformes" (menhir-stelae with idol-like representations; chronologically dating back into the Chalcolithic and onwards), estelas-guijarro (guijarro-stelae), "estelas femininas del Suroeste" (female stelae from the Southwest; Bronze Age) and "estelas antropomorfas femininas" (female anthropomorphic stelae; also attributed to the Bronze Age). M. Almagro Gorbea highlighted that these groups are closely interlinked. In his works, the *ídolos-guijarro* are described as stelae with faces or figures wearing a headdress and semi-circular necklaces draped over their chest (Almagro Gorbea 1994, 76-78). He emphasises that in the *estelas femininas del Suroeste* (female southwestern stelae), the figures were depicted in their totality and in a schematic way similar to that of the warrior stelae (Almagro Gorbea 1994, 76-78).

J. A. Barceló, on the other hand, divided them into "classic examples" („*ejemplares clásicos*"), dating to the third millennium BC, and statue-menhirs („*estatuas-menhir*"), dating between the end of the second and the middle of the first millennium BC (Barceló 1988; 1991). One of the most detailed, but also most complex typologies has been developed by S. Celestino Pérez and J. Á. Salgado Carmona: according to them, *diademada*-stelae correspond to type IV.A.2 and, in some cases, also to type IV.B.1 and possibly IV.B.3[6]. Generally, they defended a Bronze Age chronology running parallel to that of the warrior stelae (Celestino Pérez and Salgado Carmona 2011, 425, 428-431).

The latest typological approach presented in this volume categorises the finds into four types (see Paniego Díaz this volume): (1) Stelae depicting only the face (eyes, nose, and mouth) of a person, because the stone itself represents

Fig. 5: Stela from Torrejón el Rubio (after González Bornay 2021, 21).

the body. Apart from what the figure is wearing on its body (i.e. head and neck jewellery, belt), no other elements appear. (2) Stelae that are similar to type 1, with face and without torso, however the upper limbs are attached directly in the space between the diadem and necklace and the lower limbs are attached either at the same point or to the neck jewellery. Therefore, the stone as image media no longer corresponds to the person's body. (3) Stelae with face and diadem/headdress similar to type 1 and 2, but here the torso is depicted, including the lower limbs and sometimes other motifs. For example, the stelae from La Lantejuela, Negrões/Castro Verde (Fig. 3) and Torrejón el Rubio II (Fig. 5) correspond to this type.

(4) This type, on the other hand, differs most clearly from the other groups and resembles in style to the warrior stelae, showing very schematic representations of anthropomorphic figures. The face is not elaborated, limbs and torso are represented by simple lines, diadems/headdresses are either seemingly floating above/around the head or are attached to the head. Other motifs occur frequently, also together with representations of several persons. The types described by P. Paniego Díaz (this volume) are also accompanied by a common spatial distribution; all examples of types 3 and 4 (with the exception of Torrejón el Rubio

[6] This applies only, if El Viso III is considered a scenic representation in the sense of S. Celestino Pérez's type IV.B.3. However, the *ídolos-guijarro* are not explicitly included in this contribution.

II, Fig. 5) come from the Guadiana or Guadalquivir valleys. However, there are also some type 1 specimens (such as Granja de Toniñuelo/Jerez de los Caballeros, Bodonal, Arronches/Rebolo) in the Guadiana valley.

Unfortunately, the scientific significance of typology with regard to chronology remains limited as long as no absolute data is available. Generally, it might be important to differentiate between representations with limbs where the rock is only the image media or a projection screen, and stelae where the rock itself embodies a personality, even though the rock is not necessarily shaped in an anthropomorphic way (Araque Gonzalez 2018, 18). This is also noteworthy because it may indicate a parallel development of *diademada*-stelae and warrior-stelae: specimens of both groups are represented in both of the categories described here (Santos 2010, 55). Whether they were made at the same time or whether there was a chronological development from one to the other has not yet been definitively clarified.

3. Contexts and relations: locating *ídolos* and stelae

In order to understand the complexity and versatility of this cultural phenomenon it is necessary to take a closer look at the contexts of the stelae, both their specific find contexts and, more importantly, their overall contexts. This is not only to understand better their role in society, but because it gives some useful implications on their chronology and shows the level of regional and even supra-regional connectivity in prehistoric societies. Due to the circumstances of their discovery, the archaeological contexts are admittedly mostly missing which is a well-known problem that affects all stelae of any type or regional group. Overall, however, a relative spatial proximity to each other of both find groups can be recognised. In some cases finds could be associated with burials (e.g. Hernán Pérez, Cerezal/Nuñomoral, Arrozereco/Caminomorisco, Almadén de la Plata, Zebros I), but so far no contemporaneity or direct relation could be consistently verified (Cardoso 2011, 97-103; Santos 2009, 18-23). Despite this, for some researchers an association with funerary rites has become a decisive aspect for the interpretation, for example for S. Celestino Pérez (Celestino Pérez 2001, 250-260) or M. C. Sevillano San José, who also speaks of a ritual function of stelae in a funerary context ("función ritual funeraria", Sevillano San José 1991, 115). If this would be true, it would of course be an important point of reference for the contextualisation of the finds, however up until now there is no evidence of contemporaneity of burials and stelae.

Another much-debated aspect is the proximity of stelae and *ídolos-guijarro* to megalithic structures, which has been observed in several cases (Bueno Ramírez and Balbín Behrmann 1997, 100, 118; Bueno Ramírez and González Cordero 1995; see Díaz-Guardamino 2010, 27). For example, the finds of Hernán Pérez I and III, Arrocerezo/Caminomorisco, but also Granja de Toniñuelo/Jerez de los Caballeros (Santos 2009, 23) each were related in some way to the remains of megalithic structures. However, according to M. Santos (Santos 2009, 24), this spatial proximity does not necessarily mean contemporaneity, which could again not be proven with certainty! It was not uncommon that older structures were re-used or re-dedicated in later periods (Santos 2009, 24).

There are various points of reference for categorising the *diademada*-stelae and *ídolos-guijarro* within a broader iconographical context. Some of the north-western statue-menhirs such as Alto da Escrita or Nave 2 show very similar motifs (neck jewellery, belt), suggesting a possible connection to the *ídolos-guijarro* (Díaz-Guardamino 2010, 28; Rodríguez Corral 2018, 53-54 + fig. 11). Moreover, there are also links to LBA warrior stelae, especially in the cases of Hernán Pérez and Almadén de la Plata: in Hernán Pérez, one warrior stelae was found together with seven *ídolos* and in Almadén de la Plata the stela Almadén de la Plata II clearly depicts an armed warrior together with a person wearing a diadem/headdress. This is also the case in Almadén II/El Mesto and maybe even in Almadén III/Quinto del Hierro.

With regards to the iconographic relations of stelae and *ídolos-guijarro* with chalcolithic imagery that is claimed by some researchers, it can be stated that on closer inspection no parallels or at best some superficial similarities are discernible. The rectangular motifs on the stelae Tabuyo del Monte, Sejos I and II, as well as used in various petroglyphs, bear no resemblance at all (or only with a great deal of imagination) to what can be recognised on the *ídolos-guijarro*. Also the statue-menhirs from the sites Almendres or Portela de Mogos have nothing in common with the images depicted on *diademada*-stelae and *ídolos-guijarro* (Santos 2010, 52 + fig. 7 and 8). Although anthropomorphism also plays an important role in the imagery of the idols from the Chalcolithic, other aspects and body parts are emphasised in these older depictions. The most characteristic motifs of the *diademada*-stelae and *ídolos*, headdresses and necklaces that can be recognised as such, do not appear at all, or if they do, they are not depicted in the same way. Instead, the general focus of those early anthropomorphic representations is much more on the eye area (eyes, eyebrows, implied nose), the eyes being remarkably big and accentuated in many cases. The eyes on diademada-stelae and *ídolos-guijarro* however, are represented in the form of two small cup-marks and eyebrows only occur only on rare occasions (Fig. 6).

Fig. 6: A: Ídolo-guijarro from Cambrocino/Caminomorisco (height: 54 cm); B: "Eye-idol" made of schist, 3600-2500 BC, from Granja de Céspedes, Badajoz (height: 21 cm); C: "Eye-idol" made of limestone, 3000-2500 BC, from Cabezo de El Conquero, Huelva (height: 19 cm); unscaled (after Sevillano San José 1991, 104; Bueno Ramírez and Soler Díaz 2021 a, 82, 89).

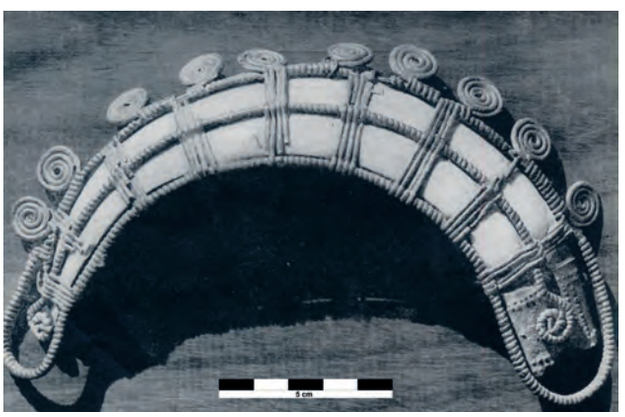

Fig. 7: "Diadem" or pendant from the necropolis of La Colombine (Champlay, Yonne, France), burial no. 101 (after Lacroix 1956, 49).

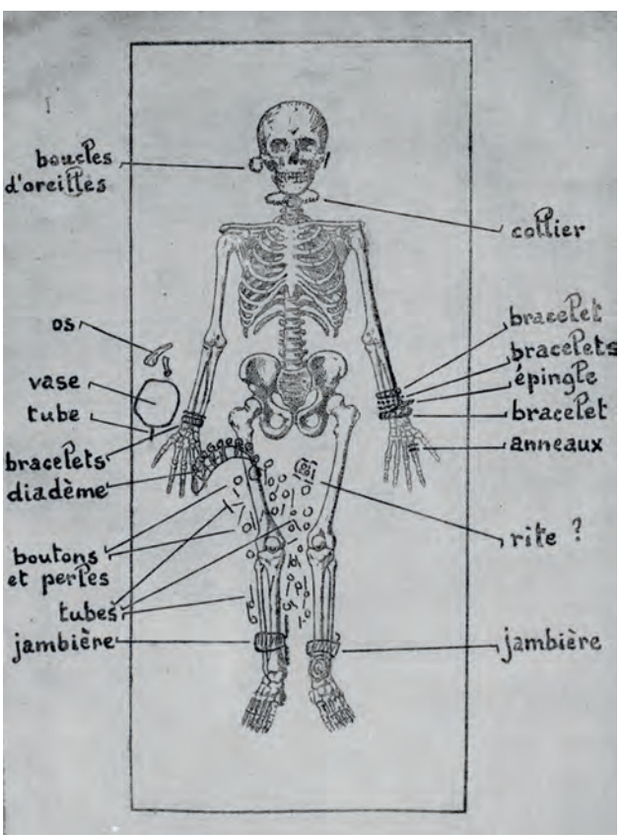

Fig. 8: Plan of the burial no. 101 in La Colombine (Champlay, Yonne, France). According to this drawing, the diadem has been found in the hip area (Lacroix 1956, 27; Drawing by Georges Bolnat).

Altogether, there is a large number of geometric motifs that are difficult to interpret in the head and face area of chalcolithic idols and stelae/statue-menhirs. The latter could just as well represent hair or hairstyles, tattoos, paintings or scarifications. By connecting the iconography of *diademada*-stelae, and especially *ídolos-guijarro*, to motifs of megalithic art occurring on idols or plaques, idols made from phalanges, baetils or ceramics (Bueno Ramírez 1987, 449) a subjective, possibly purely artificial connection that cannot be verified from an iconographic point of view has been established. The remarkable site of Cabeço da Mina (Vale da Vilariça/Vila Flor) with its outstanding group of decorated and undecorated stelae shows that there could have been multi-phase sites which explains why Chalcolithic and Bronze Age specimens occur at the same location. It has been noted that the stelae (or fragments of stelae, cf. stelae no. 3, 4, 19, 22; Campos 2019, 65) found there display a set of necklaces that show considerable resemblances to other *ídolos-guijarro* (Campos 2019, 64). A Bronze Age or perhaps even Iron Age context is also assumed for decorated schist plaques from the same site (Campos 2019, 65).

As far as *diademada*-stelae are concerned, there are unfortunately only few comparable finds of headdresses and other objects that are depicted on these monuments. In the 1950s, an artefact made of bronze wire and a boar tusk was

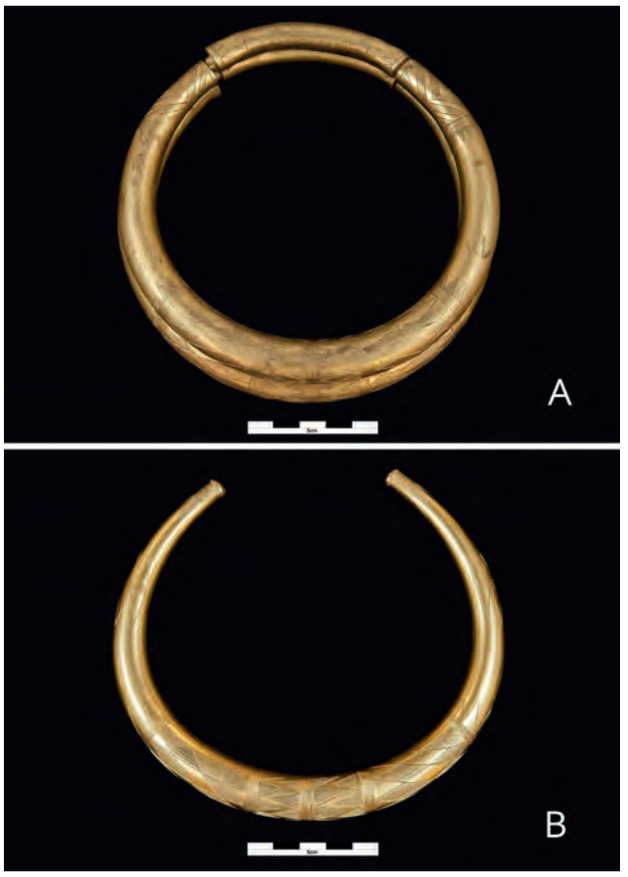

Fig. 9: Golden Torques from A: Sagrajas (Badajoz) and B: El Terrero, Berzocana (Logrosán, Cáceres) (after Museo Arqueológico Nacional, Madrid, Inv. 1970/30/1 and 1965/9/1, Photos: Susana Vicente Galende).

found in La Colombine, burial no. 101 (Champlay, Yonne, France), which dates to the 9th century BC (Fig. 7).

Another potential diadem was found in Les Grèves (Barbuise-Courtavant, Aube, France), R. J. Harrison argues, however, that it could also be some kind of pendant due to the discovery of the artefact in the hip area of the inhumation burial (Fig. 8; Harrison 2004, 163-164).

Nevertheless, these two finds have striking morphological similarities with the motifs on the stelae. Since both of them have been found in rich burials of women they are also considered a part of female furnishings and dress and jewellery (Celestino Pérez 2001, 252-254; Santos 2010, 50-52). Another possible connection could link the motifs on *ídolos* and stelae to Iberian gold jewellery, for example, the gold torques from the Sagrajas and Berzocana hoards (Fig. 9; Almagro Gorbea 1977, 61; Araque Gonzalez 2018, 245; Armbruster 2000, 138-142; Berrocal-Rangel 1987, 90-92; Díaz-Guardamino 2010, 241-250; Perea and Armbruster 2008).

According to M. Almagro Gorbea and L. Berrocal-Rangel, there also might be a point of reference for some of the depicted jewellery in the remarkable finds from Mérida (Badajoz, Extremadura) and Aliseda (Cáceres, Extremadura). The latter have often been thought to be linked to female burials (Almagro Gorbea 1977, 35-38, 61; Berrocal-Rangel 1987, 90; Zarzalejos Prieto, Esteban Borrajo and Hevia Gómez 2011, 403), which would support the hypothesis that figures wearing layered necklaces and diadems represent women. However, in these particular cases this could not be confirmed, as very little is known about the circumstances of their discovery. For the deposit from Mérida, neither the exact location, nor its archaeological context have been recorded (Enríquez Navascués 2017, 96-98). In Aliseda, no human bones have been observed and possible remains of a burial or other structures in the immediate surroundings of the deposit have been destroyed in the course of the looting of the site in 1920 (Almagro Gorbea 1977, 204; Mélida 1921, 5-7).

4. Chronology

The study of *ídolos-guijarro* and *diademada*-stelae has unfortunately always been characterised by uncertainties with regard to the dating of the finds. Until today, there are still very different dating approaches and lines of argumentation, of which I would like to provide an overview. In general, there are two main chronological approaches: the first one, established by P. Bueno Ramírez, attributes the *ídolos-guijarro* to the Chalcolithic by linking them to typical imagery and megalithic monuments (Bueno Ramírez 1987; Bueno Ramírez and Balbín Behrmann 1994, 343; 1998, 56-57; Bueno Ramírez and González Cordero 1995; followed by Correia 2010). This contextualisation is based on the proximity of several finds to megalithic burials as well as on the claimed resemblances of their iconography to motifs of megalithic art within and outside the Iberian Peninsula (Bueno Ramírez and González Cordero 1995, 100-104). Especially the presumed presence of halberds of the type Carrapatas on the stelae Hernán Pérez VI and maybe the *ídolo* from Agallas (Figs. 4 + 10) is an important aspect in this context. However, it has to be critically noted that, at least in the pictures, it is hardly possible to recognise a halberd, let alone a specific type.

In accordance with the underlying assumption that the stelae emerged from the chalcolithic idols connected to dolmens ("*ídolo dolménico*"), P. Bueno Ramírez divided them into three types: firstly, a group with rectangular motifs (with or without weapons) in the Cantabria region, secondly the group of statue-menhirs and third, the south-eastern group which would have their roots in the plaques from the Alentejo (Bueno Ramírez 1981, 47-49; 1984, 605-618; 1990, 90-98; see Santos 2010, 45).

The second, more recent approach focuses on the Middle and Late Bronze Age (*Bronce Tardío* and *Bronze Final*) as origin of the *ídolos-guijarro* and is thus opposed to the more traditional chronology of P. Bueno Ramírez.

Fig. 10: Ídolo-guijarro from Agallas (after Sevillano San José 1991, 108).

According to S. Celestino Pérez, the beginning of the development of the *diademada*-stelae in general can be placed at the end of the Middle Bronze Age and evolves during the Final Bronze Age. Consequently, for him, the *ídolos-guijarro* (also referred to as *estelas con tocado de estilo naturalista*) could be dated between the end of the Middle Bronze Age and the beginning of the Final Bronze Age (Celestino Pérez 2001, 254-260). In general, it has often been criticized that the hypothesis of a chalcolithic date is to a large extent based on very fragile arguments. M. Santos for example argues that the iconography of stelae related to chalcolithic contexts, for example (Tabuyo del Monte or Sejos, is clearly different from both, the *diademada*-stelae and *ídolos-guijarro*, and they lack the prominent headdress/diadem-motif (Santos 2010, 52-53 + fig. 7; also Celestino Pérez 2001, 244; Fig. 6). Moreover, the representations of Carrapatas-type halberds seem very schematic and only appear in two cases (Hernán Pérez VI[7] and Agallas, Figs. 4 + 10), which obviously is an absolute minority of a total of 43 stelae with headdress or diadem (Santos 2010, 54-55; Sevillano San José 1991, 116). Even more important might be the observation that both halberds, if they were really represented with the alleged motifs, seem to have been carved with a different technique than the rest of the motifs (Bueno Ramírez 1987, 455; Sevillano San José 1991, 111). J. Rodríguez Corral, who discussed similar questions with regard to his research on the statue-menhirs from north-western Iberia, also points out that there is no direct connection between megalithic structures and the *ídolos-guijarro* that could be documented (Rodríguez Corral 2018, 53). He notes that there are clear parallels between the north-western menhirs and the *ídolos-guijarro* in terms of their iconography (studded belt, set of necklaces or pectorals) and thus defends a chronological attribution to the LBA (*Bronce Tardío/Final*) for both groups.

One example that fits well with this argument is the stela from Torrejón el Rubio II (Fig. 5): it shows a human figure wearing the characteristic headdress together with an antenna fibula and a comb, which indicates a comparatively late chronology from the Final Bronze Age or even Early Iron Age (Rodríguez Corral 2018, 53). Other *diademada*-stelae that definitely can be attributed to the Late Bronze Age or the Early Iron Age transition are Capilla I, Belalcázar I, El Viso III and possibly Bodonal.

M. Díaz-Guardamino was also critical of the chalcolithic dating in her summary of the state of current research (Díaz-Guardamino 2010, 27-28). She noted that P. Bueno Ramírez's references to chalcolithic contexts were often based on oral accounts of finds that have since disappeared. Furthermore, there are no stratigraphic relations of the finds that could prove an early date (Díaz-Guardamino 2010, 27). Consequently, it seems more reasonable to accept a later chronology, which also corresponds to the obvious connection with other groups of south-western stelae.

M. Santos, who also criticized the artificiality and intricacy resulting from the increasing number of different typologies and their respective subtypes, suggested two phases of development corresponding to her own typology (Santos 2010, 55). Considering the headdress as the decisive criterion, she claimed that there were only two groups of *diademada*-stelae, which differ in iconography and regional distribution: first, the older *estelas guijarro* (guijarro-stelae), described as more naturalistic anthropomorphic representations with depictions of the face and upper limbs generally folded over the belly (Santos 2010, 49; see Almagro Gorbea 1994, 71-80). Second, the *diademadas esquemáticas* (schematic *diademada*-stelae) that were contemporaneous to those stelae where the warrior is depicted as a person (Type B after Paniego Díaz this volume; Santos 2010, 49, 55). Following this argument, the relations to the abovementioned stelae with the warrior as main theme

[7] Similar motifs also appear on the stelae Tabuyo del Monte and Soalar, Sejos, Peña Tú (Santos 2010, 54; Sevillano San José 1991, 111).

become chronologically relevant. This is also indicated by the stelae showing a combination of *diademada*- and warrior-motifs such as Almaden de la Plata II or El Viso III (Celestino Pérez 2001, 256). Hence, there may also be at least some kind of contemporaneity of the finds of Hernán Pérez (Rodríguez Corral 2018, 53; Santos 2009, 22, 27). However, P. Bueno Ramírez observations on the role of anthropomorphic representations in megalithic contexts are not necessarily incorrect in the sense that in both periods they were a widespread cultural expression, which was indisputably relevant for society.

In general, it can be assumed that *diademada*-stelae and perhaps also the places where they were used had a long time span. This is for example corroborated by sites such as Cabeço da Mina (Vale da Vilariça/Vila Flor), Hernán Pérez, or Zebros, which are believed to have been used for funerary as well as ritual activities over a long time (Campos 2019, 64-65). Many authors therefore suggested a differentiation between early types of *diademada*-stelae and later stelae from the LBA, which have been discussed above (e.g. Rodríguez Corral 2018, 54). Despite the numerous typological approaches, the concrete chronological classification of individual stelae remains controversial. It can be stated, however, that the stelae discussed in this contribution, both *diademada*-stelae and *ídolos-guijarro* have their origin in the Bronze Age.

5. Conclusion and perspectives

Considering the current state of research, with a focus on the most recent publications, it can be stated that no agreement on the chronology of neither the *ídolos-guijarro* nor the stelae has been reached. Their chronology is still mainly based on iconography, because of the lack of contexts and archaeological finds of diagnostic objects comparable to those depicted on the stelae. Hence, there is hardly a definitive basis for either of the above discussed chronologies. However, there is a strong tendency towards dating them to the Bronze Age (c. 2200 – 800 BC). Additionally, criticisms on an early chalcolithic date have recently increased (Díaz-Guardamino 2010; Rodríguez Corral 2018; Santos 2009; 2010). Not only do substantial doubts persist whether the perceived depictions of halberds are datable elements, but there is also a lack of evidence of finds within chalcolithic contexts. Moreover, it has to be stressed that formally and iconographically the *ídolos-guijarro* are closely linked to the *diademada*-stelae, much closer than to characteristic chalcolithic images on idols and pottery. In addition to the motif of the diadem/headdress as a common element, precisely the typology shows that a strict distinction between *ídolos* and *diademada*-stelae from the LBA is not possible. Finds such as Negrões/Castro Verde (Fig. 3) or Torrejón el Rubio II (Fig. 5; Type 3 after Paniego Díaz this volume), which formally correspond to the stelae, are iconographically hardly distinguishable from the depictions on the *ídolos-guijarro*. Considering the typical chest adornment of the *ídolos-guijarro, necklaces* are less frequently displayed on LBA *diademada*-stelae, however it is noteworthy that it is very clearly and carefully depicted on the stela Capilla I. In conclusion, it is very likely that the *ídolos-guijarro* are considerably younger than originally postulated by some researchers. It is very probable that a Late Bronze (c. 1300 – 800 BC) to Early Iron Age (800 – 500 BC) chronology can be established on the basis of their iconographic similarities and the findings together with stelae. However, the long duration of this iconography is remarkable and persistent local continuities cannot be ruled out. It is also possible that there is a chronological development from *ídolos-guijarro* where the stone corresponds to the human body towards monuments where the stone is only the image media, similar to what could be observed for warrior-stelae (Díaz-Guardamino 2010, 225).

The most recent classification (see Paniego Díaz this volume) represents an important and necessary step towards re-organising the archaeological material in a meaningful way. However, since the informative value of the typology with regard to chronology is quite limited, it remains an important objective for future research to obtain more data on the contexts and possible comparable objects. Typology will play an important role here, however not in the sense of ultimately artificial, albeit formally correct, categorisations, but with the specific aim of learning more about the presumed long duration and the developments of the monuments. For example, there is a high potential for new insights on the relations between stelae, burials, and megalithic structures, which should not be misunderstood as simultaneous monuments, but rather as indications of multi-phase sites whose exact character we currently know very little about (Díaz-Guardamino *et al.* 2019; García-Sanjuán *et al.* 2006).

With regard to possible connections between the diadem-motif on the stelae and objects from the archaeological record, comparable finds are limited. The above-mentioned "diadems" from France are a good visual match, but their function and the way they were worn could not be confirmed and the finding situation in the hip area raises doubts (Figs. 7 + 8). However, archaeological finds from other regions of Europe repeatedly show that headdresses and elaborate hairstyles were a widespread phenomenon in the LBA (Díaz-Guardamino 2010, 235-240). More references can be found in the jewellery consisting of layered necklaces, which are depicted through semi-circular lines, unfortunately without further details: they may have a possible equivalent in Bronze Age torques made of gold

such as the abovementioned finds from Sagrajas and Berzocana. However, there are no perfect matches and we do not know how close to reality the images of the necklaces visible on the stelae actually were.

Another aspect that from an iconographic point of view requires further investigation are the alleged relations with chalcolithic imagery. It has been repeatedly pointed out that even with a Late Bronze Age dating there might be some parallels between certain motifs (Celestino Pérez 2001, 260). In this sense, it is necessary to gain more clarity about the character of these similarities and supposed continuities, but this must be approached with caution and under the premise that the images of the Chalcolithic may have been part of an entirely different symbolic world with dissimilar contexts and meanings. Latest studies and data hold out the prospect of a reassessment with promising results (Bueno Ramírez and Soler Díaz, 2021 b). Generally, it must be highlighted that the "Chalcolithic face" with its characteristic representations of eyes and eyebrows differs significantly from the facial scheme on the diadem stelae (Fig. 6). The observation that anthropomorphic figures and faces also played a role in depictions from the Chalcolithic is no proof of their contemporaneity (see Amor Santos, this volume).

As far as the *ídolos-guijarro* are concerned, only few new studies have been published in recent years - despite interesting new finds. Amongst the latter is one stela from Arronches/Rebolo (Bueno Ramírez, Rocha and Oliveira 2021) and the abovementioned stela from Negrões/Castro Verde (Fig. 3; Mataloto, Paniego Díaz and Morais in press), both from Portugal. The number of new finds is steadily increasing and the debates on the chronological and cultural contextualisation and interpretation of *ídolos* and stelae continue. Even if we ultimately cannot answer the question who exactly were the depicted diadem-wearers, the stelae and their imagery provide unique insights not only into clothing and accessories that were in use at that time, but also into the ideological, conceptual world of Bronze Age societies that is no longer accessible through other means.

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CHAPTER 5

From Metal Rivets to Representations: Investigating Imaginary Shields in Bronze Age Stelae from Portugal

Raquel Vilaça and *Carlo Bottaini*

Abstract

Shields play an important role in the iconography of stelae attributed to the Late Bronze Age in the western Iberian Peninsula, particularly in the context of Portuguese territory, where 13 such stelae depict their representation. However, the discrepancy between their prominence in visual representations and the lack of corresponding archaeological evidence calls for critical examination. This paper aims to investigate this incongruity by examining a specific category of metal artefacts — dome-headed rivets — that some scholars have suggested may serve as tangible traces of actual shields in Late Bronze Age communities within Portuguese territory. Through meticulous analysis, this study addresses the complex challenges involved in elucidating the functional utility of these rivets and determining their probable attachment to specific objects.

Keywords: Late Bronze Age, stelae, shields, metal artifacts, functional analysis, Portuguese territory

Resumo

Os escudos são um elemento central de muitas estelas atribuídas ao Bronze Final do Ocidente Ibérico, 13 das quais no território português. Contudo, essa centralidade não tem qualquer paralelo quando procuramos evidências no registo arqueológico, sendo os potenciais indícios de escudos reais bastante dúbios. Ao tomarmos como ponto de comparação as estelas com escudos, neste trabalho procuramos analisar uma categoria de peças metálicas - os cravos com cabeça em calote hemisférica - que alguns autores consideraram como vestígios materiais da existência de escudos reais entre as comunidades do Bronze Final no território português. Ao analisarmos essas ocorrências, pretende-se demonstrar as problemáticas que essas peças colocam quando se procura determinar a sua natureza funcional e perceber o tipo ou tipos de objectos em que seriam fixados.

Palavras-chave: Bronze Final, estelas, escudos, objectos metálicos, análises funcionais, território português

1. Introduction

Since their first discovery in the late 19th century, the Late Bronze Age stelae of western Iberia have been given different names and categorised in different ways. These classifications emphasize their geographical distribution, such as Extremadura (Almagro Gorbea 1977), Southwest (Gálan Domingo 1993) or West (Celestino and Salgado 2011), their iconography, including decorated stelae (Martín Almagro 1966) and warrior stelae (Celestino Pérez 2001), and their ethno-cultural nature (in the case of the "estelas básicas"), such as Lusitanian stelae (Almagro Gorbea 2012). Distributed mainly in the westernmost region

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of the Iberian Peninsula, they share certain recurring iconographic features, such as the depiction of weapons, especially shields.

Shields are one of the most prominent elements in the iconography of Late Bronze Age stelae, especially in Type I A (basic with shield, sword and spear) and Type I B (basic with elements of personal adornment) stelae (Celestino Pérez and Salgado Carmona 2011: 438-439). In western Iberia, however, shields are not exclusive to Late Bronze Age stelae, but also appear engraved at other sites, such as Cachão do Algarve (Beira Interior, Central Portugal) (Gomes 1989), and continue to be present until the Late Iron Age. This is evidenced by the statues of Galician warriors (González-Ruibal 2004) and the engravings of the Vale do Côa, including Vermelhosa 1 and 3, and Ribeira de Urros (Luís 2023). Despite differences in typology and representation techniques, whether carved in the round or engraved, this diachronic representation of shields underlines the importance of this defensive weapon, both in warfare and as a symbol of authority and status.

As far as Late Bronze Age stelae are concerned, shields are an essential part of the warrior's arsenal, coexisting with a range of offensive and defensive weapons, including swords, spears, helmets, and bows. Paradoxically, unlike other weapons such as swords and spearheads, the existence of shields as tangible artefacts in the archaeological record of the Portuguese Late Bronze Age is rather uncertain and subject to considerable doubt, ultimately being documented, according to some scholars, only by a few rivets found sporadically in different contexts, distributed from north to south throughout Portuguese territory[1].

It is currently not entirely clear when shields first appeared in Europe. Based on the available evidence, shields made from organic materials such as wood and leather are considered to be the earliest prototypes, with origins dating back to the Early Bronze Age (Uckelmann 2012: 164-165). Radiocarbon dating of wood used in the construction of a selection of shields from Atlantic Europe, particularly Ireland, suggests their existence in this period. For example, shields from sites such as Kilmahamogue (County Antrim), dated to 1943-1538 cal BC, and Cloonlara (County Mayo), dated to 1633-1164 cal BC, exemplify this early use (Molloy 2009: 1055). The use of organic materials in shield construction continued throughout the Middle and Late Bronze Age, as evidenced by shields found at sites such as Churchfield (County Mayo) (1392-1129 cal BC), Annadale (County Leitrim) (1258-1010 cal BC), and Cloonbrin (County Longford) (1194-934 cal BC) (Needham *et al.* 2012: 486).

With regard to the Iberian Peninsula, while the presence of shields in stelae is generally attributed to the Late Bronze Age, their presence in the archaeological record is much more uncertain. Recently, it has been suggested that leather shields may have been used in the southwestern region of the Iberian Peninsula as early as 2500 BC, possibly in conjunction with copper-arsenic arrowheads. In this scenario, shields would have been introduced as prestigious weapons within the context of trade and cultural interactions between the southern Levant and the Iberian Peninsula (Mederos Martín and Jiménez Ávila 2021: 99). However, this hypothesis is not supported by empirical data, so the presence of shields in the archaeological record of the Iberian Peninsula, as well as their chronology, remains a subject of uncertainty.

Based on the available empirical evidence, this paper analyses a collection of metallic rivets from Portuguese territory. As mentioned above, these rivets have been considered by some scholars as evidence that Late Bronze Age communities in Portugal were familiar with shields not only from their depiction on stelae, but also from their tangible counterparts. Through this analysis, the paper aims to validate the presence of shields in the archaeological record and explore the potential implications for our understanding of Bronze Age defensive technologies and social practices.

2. Shields on stelae, rivets on shields

As mentioned above, Late Bronze Age stelae from western Iberia display a wide range of artefacts, including defensive and offensive weapons, personal care items such as mirrors, combs, tweezers and brooches, musical instruments, chariots, as well as other images whose interpretation remains unclear. Human figures are prominently represented, either individually or in groups. On the other hand, other artefacts documented in the archaeological record, such as axes, sickles, spits, forks and cauldrons, are conspicuously absent from these stelae.

Among the representations of weapons on the stelae, circular motifs interpreted as shields are very common. The number of 71 stelae with shields reported by Harrison (2004: 124) has now risen to 120, which means that over 70% of the surviving stelae contain representations of shields (Celestino Pérez and Pablo Paniego, pers. commun.), a number that may be even higher if we consider that several stelae are fragmented, and the representations are incomplete. If we consider the Portuguese territory alone, the number of stelae depicting shields is 13 (Fig. 1).

[1] Although not included in the present work, it is worth mentioning an assemblage of Iron Age gold discs decorated with concentric circles from Fortios (Portalegre) and Outeiro da Cabeça (Torres Vedras), which, according to some scholars, represent miniature shields (Harrison 2004: 131-134). More recently, however, a new interpretation has been put forward, suggesting that these artefacts should be interpreted as Bronze Age 'sun discs', dating from the early second millennium BC and associated with prestigious or sacred dress (Vilaça *et al.* 2018: 380).

Figure 1: Distribution of stelae with V-notched shields (in black) and the sites of provenance of the rivets discussed in this article (in red). Stelae: 1. Castelões 1 (Chaves); 2. Castelões 2 (Chaves); 3. Tojais (Montalegre); 4. Pedra da Atalaia 1 (Celorico da Beira); 5. Baraçal 1 (Sabugal); 6. Baraçal 2 (Sabugal); 7. Aldeia Velha (Sabugal); 8. Fóios (Sabugal); 9. Meimão (Penamacor); 10. Telhado (Fundão); 11. Zebros 2 (Idanha-a-Nova); 12. Ervidel 2 (Beja); 13. Figueira (Vila do Bispo). Settlements: 1. Moinho de Golas (Montalegre); 2. Figueiredo das Donas (Vouzela); 3. Cabeço do Castro de São Romão (Seia); 4. Alegrios (Idanha-a-Nova); 5. Monte do Trigo (Idanha-a-Nova); 6. Columbeira (Bombarral); 7. Pragança (Cadaval).

Shields usually occupy a central position in the composition of stelae and are often considerably larger than the other motifs depicted. From a typological point of view, round shields of the Herzsprung type, characterised by their round shape with V- or U-shaped notches, are among the most common (Celestino Pérez 2001: 108-151; Harrison 2004: 124). This type of shield, dated to the last quarter of the 2nd millennium BC (Uckelmann 2012: 164-166), has been found in a wide range of European regions, both as an actual object and in depictions. Its distribution ranges from the eastern Mediterranean, including Greece and Cyprus, to northern Europe, including Ireland, England, Scandinavia and the Iberian Peninsula (Uckelmann 2012: table 160). This wide geographical spread suggests possible connections between these regions based on iconographic similarities, as already suggested by various authors in the mid-20th century (Hencken 1950: 303; Mac White 1951: 101-103).

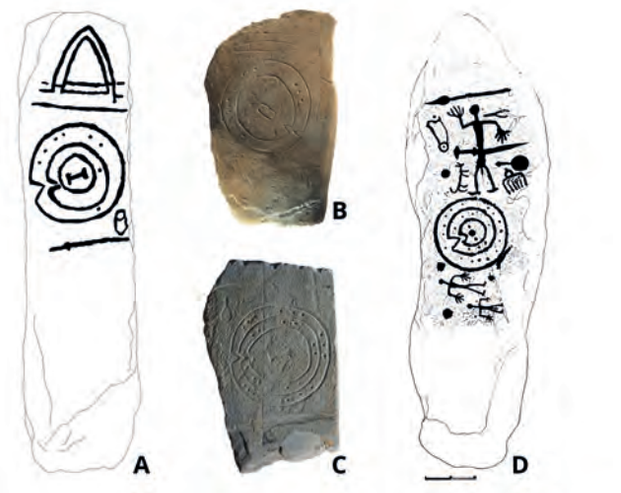

Figure 2: Stelae of Santa Ana de Trujillo (A); El Oreganal (B); Brozas (C) (according to González Bornay and Dominguez García 2021); Ervidel II (D) (according to Harrison 2004, C89).

In the Iberian Peninsula, Herzsprung-type shields can be found on numerous stelae, such as Torrejón del Rubio I, Cabeza de Buey I, Granja de Céspedes, Magacela, Olivenza, Cordoba 1, Aldea de Rey I, Figueira, Ervidel II and Meimão, etc. A common characteristic of this type of shield is the presence of rectangular handles and decorative dots between concentric rings. The dots occur in different configurations, i.e. randomly (e.g. Santa Ana de Trujillo, Fig. 2-A), Talavera de La Reina, Cabeza de Buey I), grouped in rows of two, three (e.g. El Oreganal, Fig. 2-B), five (e.g. Meimão, Torrejón del Rubio I, Magacela) or in a combined form of two/three (e.g. Solana de Cabañas, Badajoz), with rhythmic intervals between sets (e.g. Brozas, Fig. 2-C), isolated and distributed in a balanced manner (e.g. Córdoba II), or continuously and intensively filling the shield field (e.g. Ervidel II) (Fig. 2-D).

Although some authors ascribe a symbolic meaning imbued with astral significance to these dots, especially when arranged around certain patterns (Tejera Gaspar and Fernández Rodríguez 2012: 86-87), the prevailing and most credible interpretation suggests that they are decorative rivets intended for fastening, similar to those found in contemporary shields made of metal or organic materials (such as wood and leather) (Coffyn 1985: 176; 208; Harrison 2004: 53). Indeed, the use of metal rivets in physical shields is relatively well documented, as exemplified by a shield from Tomb 1 at Wollmesheim (Germany) which contained 69 rivets, some still embedded in the wood of which the shield was made (Coles 1962: 171; Sperber 1999, fig. 6), and another from the burial of the «warrior chief» at Hagenau (Germany), which was decorated with 43 bronze rivets of various types and sizes (Harrison 2004: 131; Uckelmann 2012: figs. 148-149).

3. Shield rivets in the Portuguese Late Bronze Age. Reality or illusion?

Rivets are extremely rare objects in Late Bronze Age metallurgical production in Portugal. However, this study does not aim to create a comprehensive corpus that systematically divides this specific type of artefact into different subtypes, mainly based on the type of head and the shape of the shafts. Instead, the focus is on those specimens that may shed light on their possible function as components of tangible shields. Rivets made of materials other than copper-based alloys, as well as those with flat heads or lacking a hemispherical head similar to those depicted on stelae shields, have been excluded from our analysis. Rivets with conical heads, analogous to those observed on helmets, such as the one depicted on the stele from Telhado (Fundão) (Fig. 3-A) (Mederos Martín 2019: 281; Vilaça 2021: 329, Fig. 3) and possibly related to a rivet from Castro de Tavarede (Figueira da Foz), previously identified as a pin (Rocha 1971: 114, Fig. 5) and recently reclassified by the authors (Fig. 3-B), were not included in this study.

On the basis of these parameters, a total of 15 Late Bronze Age dome-head rivets have been identified on Portuguese territory (Table 1)[2], although only some of these rivets have been explicitly linked in the literature to possible use in shields. Examples of such specimens are those found at Figueiredo das Donas (Vouzela) (Rodrigues n.d.: 229; Coffyn 1985: 174, 224; Silva 1986: 181; Figueiredo *et al.* 2011: 1206; Figueiredo 2021: 127), Cabeço do Castro de São Romão (Seia) (Senna-Martinez 1989: 238, 247, pl. CCXLVII; Gil *et al.* 1989) and Columbeira (Bombarral) (Schubart *et al.* 1969). The remaining rivets in Table 1 are either unpublished, such as those from Monte do Trigo, or have been published previously without much detail on their functionality (Fig. 4).

In an overall analysis, the first aspect to consider when examining the rivets listed in Table 1 is that most of them come from rather uncertain and poorly defined archaeological contexts. The rivets from Moinho de Golas (Montalegre) (Fonte *et al.* 2013: 28, fig. 10) and the six rivets from Figueiredo das Donas (Vouzela) were found accidentally and mixed with various other materials, sometimes with different chronologies. In the latter case, for example, the rivets were found together with Late Bronze Age metal

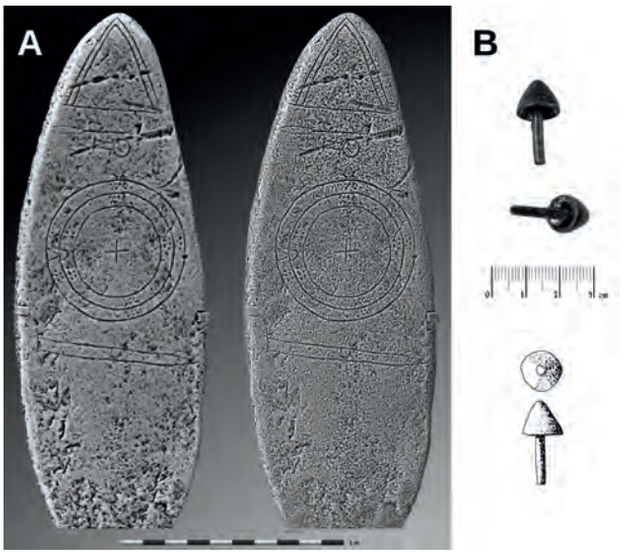

Figure 3: Telhado stela reproduced based on the Morphological Residue Model algorithm (Pires *et al.* 2015), showing the helmet with rivets near the base (A), according to Vilaça 2021: 329; rivet from the Crasto de Tavarede (Figueira da Foz) (B). Photos RV / CB.

Figure 4: Dome-headed rivets from Portuguese territory. Moinho de Golas (A); Figueiredo das Donas (B); Cabeço do Castro de São Romão (C); Alegrios (D); Monte do Trigo (E); Columbeira (F); Pragança (G). Bibliographical references to each site are given in the text.

artefacts, such as a Porto de Mós-type dagger and a Rocanes-type sickle, but also with material of a different chronology, such as tegulas and building debris, as reported in a local newspaper shortly after the discovery ("Notícias de Vouzela", nº 21, de 17/11/1959). The rivets from Pragança (Cadaval) (Melo 2023: 163, 254, 354, 409) and Columbeira (Bombarral) (Schubart *et al.* 1969: 32, fig. 8) were found during ancient archaeological excavations and their archaeological context remains somewhat ambiguous or insufficiently defined. The remaining rivets come from more recently excavated settlements, such as Alegrios (Idanha-a-Nova) (Vilaça 1995: 179 and pl. CLXIII-12), Cabeço do Castro de S. Romão (Seia) (Senna-Martinez

[2] We have not included in the table an unpublished rivet from the Late Bronze Age settlement of Tapada da Ajuda, excavated by João Luís Cardoso (Melo 2023: 163, 254), which is currently under study (see also Melo and Cardoso 2024). Furthermore, a rivet from Pragança (no. 983.299.136) was not included in the table because its head was incomplete (Melo 2023: 163). However, we have included another dome headed rivet (no. 986.161.2114), which was published as a button (Melo 2023: 354) and which should correspond to a dome -headed rivet with a shaft, based on another publication with a clearer image and where the piece is identified as a possible 'nail from the helmet' (Figueiredo 2012: 56, tabs. 3.4 and 3.5).

Table 1: List of head-dome rivets from the Portuguese territory. With the except of Figueiredo das Donas, Monte do Trigo and Alegrios, the remaining sizes are based on bibliographic information. * Only complete pieces are considered. n.a.: not available.

Provenance	Quantity	Context of finding	Diameter of the heads (mm)	Length of the shaft (cm)*
Figueiredo das Donas	6	Unknown	41; 43; 42; 42;41; 43	3.8
Columbeira	2	Settlement	10; 12	1.5
Monte do Trigo	2	Settlement	13; 14	2.4
Alegrios	1	Settlement	12	1.1
Castro de São Romão	1	Settlement	c. 21	n.a.
Castro de Pragança	2	Settlement	14; 14	5.2
Moinho de Golas	1	Settlement	19	2.3

1989: 238, 247, pl. CCXLVII) and Monte do Trigo (Idanha-a-Nova) (Vilaça 2008: 287-288), thus have a more solid chronostratigraphic framework.

Under these circumstances, it is clear that although the rivets considered in this paper are commonly associated with the Late Bronze Age, their origin from contexts that often lack clear stratigraphic and chronological delimitation makes it difficult to assign all of them unequivocally to this period. The available analytical data itself seems to be rather contradictory, as not all the dome-headed rivets analysed so far have the chemical composition expected for Late Bronze Age objects. The rivets from Pragança (Melo 2023: 163, 254), Figueiredo das Donas (Figueiredo *et al.* 2011: 1208) and Moinho de Golas (Fonte *et al.* 2013: 30) were made of bronze alloys containing copper and tin, which is in line with our understanding of Late Bronze Age metallurgy. In contrast, the rivets from Cabeço do Castro de São Romão were primarily composed of much purer copper (Gil *et al.* 1989: 239), with a probably deliberately gilded surface only on the visible side (Figueiredo 2010: 98-99). This composition is unusual for the Late Bronze Age and stands in stark contrast to the other metal objects found in the settlement.

Whatever their origin, it is noteworthy that most rivets were found in apparent association with other metals, including weapons. For example, small daggers are associated with the rivets from Columbeira (Schubart 1969: 32), Moinho de Golas (Fonte *et al.* 2013: 26) and Figueiredo das Donas (Figueiredo 1959); at Alegrios, the rivets come from contexts where daggers and an arrowhead were also found (Vilaça 1995: est. CLXIII); at Cabeço do Castro de São Romão, the rivet appears in contemporary contexts with a spearhead (Gil *et al.* 1989: 239); at Monte do Trigo, the rivets come from the same archaeological levels where, among other artefacts, Late Bronze Age daggers have been found (work in progress). On the basis of these empirical data, we can conclude that if the shields depicted on the stelae were found in association with weapons such as swords and/or spearheads, such a situation would not occur in the archaeological record. In fact, even assuming that the rivets in question were indeed parts of shields, such shields would be found in contexts associated with smaller weapons and quite different typological objects.

In terms of geographical distribution, dome-head rivets have only been identified in 7 archaeological sites, and their locations do not necessarily correspond to the distribution of stelae with shields. In fact, according to Figure 1, the sites more closely correlated with stelae with shields are Moinho de Golas, in the north (Fonte *et al.* 2013: 26), and Alegrios and Monte do Trigo, in the Beira Interior region, in central Portugal (Vilaça 2008: 387-388).

Another very interesting aspect worth highlighting are the morphological characteristics of the domed rivets. Apart from the formal variables, it is their dimensions that attract the most attention. For example, based on the dimensions of the head, two different groups can be identified. The first consists of rivets with smaller heads, between 10 and 21 mm in diameter, and includes specimens from Columbeira, Monte do Trigo, Alegrios, Cabeço do Castro de São Romão, Pragança and Moinho de Golas. The second group consists of rivets from Figueiredo das Donas (Fig. 5), with heads between 41 and 43 mm in diameter - twice as large as those in group 1 (Fig. 6 A). In the latter case, the objects are heavier, not only because of their size, but also because of the thickness of the heads, which can reach 2.5 mm. The heaviest rivet from Fi-

Figure 5: Rivets from Figueiredo das Donas (Vouzela). Bottom view (A). Side and top views (B). Photos RV / CB.

gueiredo das Donas weighs 71 g, which contrasts sharply with one of the rivets from Monte do Trigo, for example, which weighs 2 g.

In a wider geographical comparison, the rivets of Group 1 have dimensions very similar to those of other known Late Bronze Age examples from Western Europe. For example, in the Saint-Brieuc-des-Iffs deposit (France) the hemispherical heads have a diameter of up to 22 mm (Briard and Onnée 1972: 14, pl. XIV-117), while in the Vénat hoard (France) the heads of various rivets vary in size, the largest being about 23 mm (Coffyn *et al.* 1981: pl. 48). In addition, the 69 decorative rivets from the shield in tomb 1 of the Wollmesheim necropolis (Germany) have heads between 8 and 12 mm in diameter (Coles 1962: 171; Sperber 1999: fig. 6). On the western peninsula, the rivets from the chariot in tomb 17 of the necropolis of La Joya (Huelva), dated to the 8th-7th century BC (Jiménez Ávila 2018: 202, fig. 9, line 1), are similar in size to those from Columbeira, Alegrios and Monte do Trigo. In contrast, the Figueiredo das Donas specimens are clearly of an unusually large size and, to the best of the authors' knowledge, have no close parallels in the Iberian Peninsula.

Where they are present, the shafts of the rivets, which are mostly circular in cross section, vary considerably in size (Fig. 5 B), but mostly do not exceed 2.3 cm, as observed in Moinho de Golas. Once again, Figueiredo das Donas seems to be an exception. In fact, the shaft preserved in one of the rivets has an unusually long length of 3.8 cm (considering only the dimension from the tip to the underside of the head). The shafts of the remaining rivets are fragmented, although it is unlikely that they differ significantly in length from the complete examples. Similarly, one of the rivets from Pragança measures 5.2 cm in length (Melo 2023: 409). However, the fact that it is the only known example with a subquadrangular cross section and with a variable thickness, i.e. thinner at the tip and wider in the upper half, clearly places this piece in a different category of rivets.

In light of the aforementioned considerations, it becomes evident that if the majority of dome-head rivets discovered in the Portuguese Late Bronze Age have dimen-

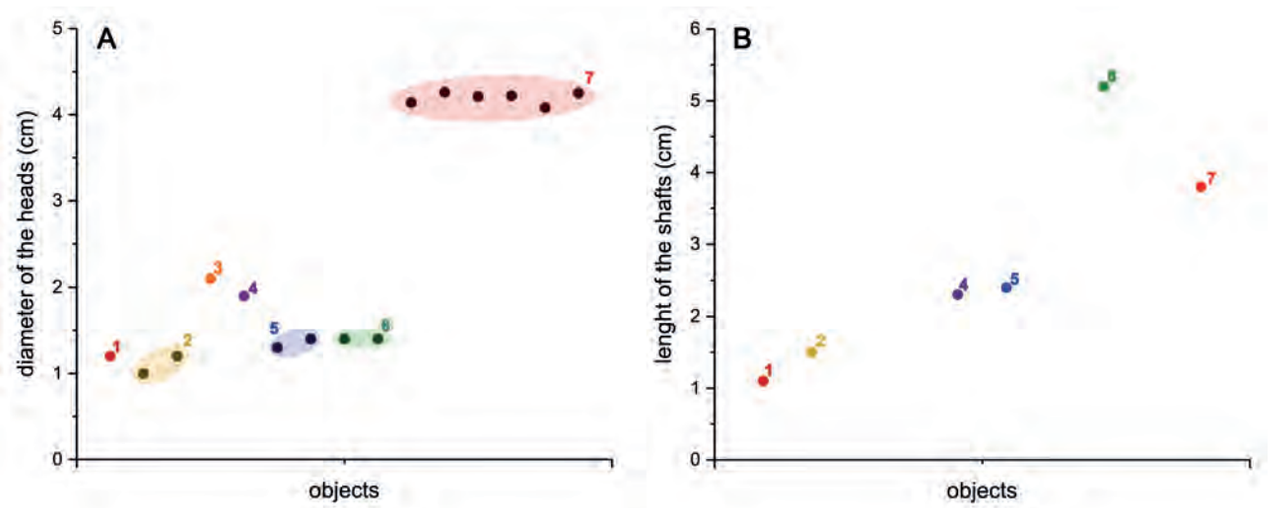

Figure 6: Diagrams of the diameter of the rivet heads (A), highlighting the uniqueness of the Figueiredo das Donas group, and the size of the shafts (B). 1. Alegrios; 2. Columbeira; 3. Cabeço do Castro de São Romão; 4. Moinho de Golas; 5. Monte do Trigo; 6. Pragança; 7. Figueiredo das Donas.

Table 2: Thickness of a representative selected group of European wood and leather shields.
(*) According to Coles (1962: 180), the original piece of wood was c. 10 cm thick and was shaved down to a uniform thickness of 1.2 cm; it is 13 mm thick.

Provenance	Material	Thick (cm)	Bibliography
Cloonbrin (Ireland)	leather	0.5-0.6	Coles 1962: 175; Molloy 2020: 27
Churchfield (Ireland)	wood	6	Coles, 1962: 180
Annandale (Ireland)	wood	10	Molloy 2009: 1055 (*)
Kilmahamogue (Ireland)	wood	4.3	Coles 1962: 181
Cloonlara (Ireland)	wood	3.5	Coles, 1962: 180
Wollmesheim (Germany)	wood	<2	Coles 1962: 171

sions more suitable for integration into a shield, it is clear that the rivets from Figueiredo das Donas, although explicitly identified as components of a shield (Coffyn 1985: 174, 224; Silva 1986: 181; Figueiredo *et al.* 2011: 1206; 2021: 127). This presents a challenge in determining their functional purpose and in identifying the specific type of object to which they would have been attached. While it can be excluded that they were used for shields made of materials such as metal or leather, it cannot be ruled out a priori that they were used for wooden shields, such as some pieces from Ireland, which would require rivets with longer shafts like those from Figueiredo das Donas (Table 2). It is also possible that these rivets were used to join or decorate other types of more robust and solid wooden supports, such as furniture elements.

Another noteworthy observation is that, with the exception of Monte do Trigo, Columbeira, Pragança and Figueiredo das Donas, all other sites yielded a single rivet each. Given the necessity of a much larger number of rivets to construct a shield, it would be logical to anticipate a higher concentration of rivets from the same site. This trend is corroborated by an analysis of other findings, such as the Vénat (France) hoard, from which 24 rivets were recovered (Coffyn *et al.* 1981: pl. 48).

The archaeological evidence for Late Bronze Age material shields from Portuguese territory appears to be weak, based on the available empirical data. The lack of clear functional attribution to rivets, coupled with the absence of other reliable evidence, has led some authors, such as Needham (1979: 130), to propose that shields existed only in representational form among Late Bronze Age communities in the Iberian Peninsula, rather than as tangible artefacts. Conversely, the available data do not permit the conclusion that Late Bronze Age Portuguese communities did not manipulate real shields. This is because western Iberian communities were familiar with such objects from their depiction on stelae and had supra-regional links with other areas of the Atlantic and Mediterranean world where the use of shields is well documented.

As a working hypothesis, it could be advanced that the visibility of tangible shields in the archaeological record may be ascribed to environmental factors that affected the preservation of organic materials, which may have been used for the production of shields. In regions such as Ireland, for example, favourable conditions have permitted the preservation of shields crafted from organic materials. These include the leather shield from Clonbrin (Longford) and the wooden shields from Churchfield (Mayo), Cloonlara (Mayo), Annandale (Leitrim), and Kilmahamogue (Neagh) (for a more detailed bibliography, see Uckelmann 2012). However, comparable preservation conditions do not exist in Portugal, which may explain why these materials, although once present, have likely deteriorated.

On the basis of the available evidence, it can be concluded that the weapons produced and used by Late Bronze Age communities in the western Iberian Peninsula were predominantly offensive in nature, including swords, spearheads and daggers. It can also be argued that defensive weapons, such as shields and helmets, were primarily symbolic objects, known only from stelae and perhaps part of a shared symbolic language among social elites, as previously suggested by Galán Domingo (1993, 52). This is supported by other cases not considered in this text, such as Vila Cova de Perrinho (central Portugal) (Bottaini and Rodrigues 2011), where some fragmented metal sheets have been questionably attributed to a helmet. This framework suggests that the primary purpose of Bronze Age

shields was probably ceremonial and prestigious, rather than practical for physical combat (Coles *et al.* 1999, 44).

4. Final remarks

As has been emphasised throughout this paper, the dome-headed rivets from Portuguese territory, some of which are undoubtedly contemporary with the stelae depicting shields, show considerable heterogeneity in several respects. In other words, they are not standardised productions, but objects that vary in shape, size and weight. As mentioned above, the six rivets from Figueiredo das Donas stand out from the rest of the assemblage, particularly in terms of size, weight and quantity, suggesting a scenario of mass production, as they represent the largest concentration of rivets from a single context.

These characteristics allow us to state with some confidence that not all of the 15 rivets were used in the production of the same type of artefact. Although we still do not understand what these objects were used for, the data allow us to question Harrison's (2004, 53) assertion that 'not even a rivet' existed in the Late Bronze Age of western Iberia as evidence for the existence of tangible shields.

In conclusion, the central question of this study - whether these rivets attributed to the Portuguese Late Bronze Age can be definitively associated with potentially authentic shields - remains inconclusive in our view. It is plausible to acknowledge that our understanding of Late Bronze Age shields in Portugal may be significantly influenced by the adverse environmental conditions of the Iberian Peninsula, which have probably hindered the preservation of organic materials over the centuries, in contrast to other regions such as Ireland. Nevertheless, based on the current state of knowledge, we have to admit that Late Bronze Age communities in Portuguese territory were familiar with shields through their depiction on stelae, but did not necessarily manufacture or directly use them. If this perspective proves to be valid in the future, we will have to acknowledge that shields, even in the Late Bronze Age, were objects of symbolic and prestige value rather than practical weapons, probably serving as indicators of long-distance contacts with other Atlantic, Continental and/or Mediterranean worlds.

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CHAPTER 6

The import elements represented on the stelae of the West. New questions for old friends

Guiomar Pulido-González

Abstract

The number of western Iberian stelae documented in the Peninsula has continued to increase until the present day. Their growing number provides researchers with new examples that add to the information about the elements represented and allow us to consider traditional questions from new angles. Therefore, we propose to use the representations of imported elements on the stelae, such as combs, mirrors, and lyres, as the guiding thread of our thesis. Analysing the greater or lesser presence of these elements in the compositions of the stelae will enable us to establish the preferences between one area and another for certain objects of Mediterranean origin and detect the likely routes of the arrival of these imports. Therefore, the representations on the stelae are a tool to discern the connections that articulated the communication between the inland territories of the Iberian Peninsula in a period of great economic and cultural dynamism motivated by the contacts between indigenous communities and those from the Eastern Mediterranean.

Keywords: inland trade routes, Mediterranean imports, ironworking, Phoenician colonisation

Resumen

El número de estelas del Oeste documentadas en la península ibérica no ha dejado de ascender hasta la actualidad. Su creciente registro brinda a la investigación nuevos ejemplos que aumentan la información sobre los elementos representados y permite plantear nuevas perspectivas para cuestiones ya clásicas. A este respecto, planteamos tomar como hilo conductor de nuestra disertación las representaciones de elementos importados en las estelas, como los peines, los espejos o las liras. El análisis de la mayor o menor presencia de estos elementos en las composiciones de las estelas permitirá establecer las preferencias entre unas zonas y otras por determinados objetos de origen mediterráneo, así como detectar las posibles rutas de llegada de esas importaciones. Así, las representaciones de las estelas resultan una herramienta para vislumbrar las conexiones que articularon la comunicación entre los territorios interiores de la península ibérica en una etapa de gran dinamismo económico y cultural motivada por los contactos entre las comunidades de origen oriental y las indígenas.

Palabras clave: rutas interiores de comercio, importaciones mediterráneas, trabajo del hierro, colonización fenicia

1. Introduction

Since the first example was documented in 1898, the number of western stelae on the Iberian Peninsula has increased steadily up to the present day, with more than 160 in total. Their growing number provides research with varied examples that increase the information on these elements and allow new perspectives on classic questions to be raised, after decades of scientific publications and a succession of hypotheses. This enormous amount of bibliography is the result of an attempt to mitigate the frustration produced by the constant absence of certainty on this issue

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Figure 1. Distribution map of stelae with depictions of Mediterranean imports.

because of the schematic iconography and the missing archaeological contexts of most of the stelae.

In short, much has been written and debated about their function, meaning, typology, the cultural substratum to which they belonged, chronology, etc. However, on this occasion we do not plan to get lost in this *mare magnum* of discussions that have given rise to an endless bibliography; rather, we will avoid many of the traditional questions that specialists have posed for the stelae. Instead, we focus not on the stelae themselves as the main object of study, but on other aspects linked to the processes that the stelae reflect in a more or less expressive way, depending on the case.

To this end, we have taken as a common thread the representations of imported elements, such as chariots, combs, mirrors, and lyres. The discarding of other elements traditionally conceived as imports, for example the fibulae (Celestino, 2001: 200-206), has been due to the conclusions reached by recent research, which has made clear that they were an autochthonous development during the Late Bronze Age (Carrasco and Pacheco 2006; 2012; Carrasco, Pachón and Gámiz 2016).

The appearance of imports on the stelae reveals a whole process of interaction and exchange with people of Eastern Mediterranean origin who were settling in the south of the Iberian Peninsula and were included in the exchange networks that were already established among the local population. The aim of this contribution is the characterisation of this process as well as the mechanisms that had to be put in place, taking the stelae as the means to obtain a glimpse on the connections that articulated this communication between the inland territories and the southwest coast of the Iberian Peninsula in a period of great economic and cultural dynamism motivated by the contacts between the communities of eastern origin and the indigenous communities.

For this reason, this paper will focus on the evidence of imports as shown on the stelae, without dwelling too deeply into the stelae phenomenon and the debates concerning them.

2. The imports represented on the stelae

2.1 Chariots

The chariot is conceived as a status-marking attribute and aristocratic symbolism throughout the Mediterranean basin. The provision of the means to drive it, that is, two draft animals, usually horses, as well as to build and maintain it, was a sign of the economic capacity and rank of the individual. The depictions of chariots were made by people who ignored the graphical perspective and oblique projection (see Huth, this volume). Therefore, these artists solved the problem of representation with a mixed-top down projection, which is a common phenomenon in many regions and chronologies (cf. Grahn, 2022).

The chariot motif has been widely discussed by various specialists (Almagro-Gorbea 1977; Fernández Miranda and Olmos 1986; Blázquez 1986; Quesada 1994; Mederos and Harrison 1996; Almagro-Gorbea 1977; Barceló 1989; Celestino 2001; Mederos 2008), generating a bibliography whose reading leads to the conclusion that they are of Mediterranean origin, as further specification would be problematic given the schematic nature of the representations.

In this case, the introduction of the chariot in the Iberian Peninsula would have occurred as a result of the Phoenician settlement in the Southwest. This could be deducted from the distribution of the motif throughout the Peninsula, appearing in the area extending from the middle valley of the Guadalquivir to the middle valley of the Tagus, being absent in the northern regions, which were more closely linked to the Atlantic and Central European spheres (Figure 2). Furthermore, the only analogous example found in the archaeological record of the Iberian Peninsula is the well-known chariot from tomb 17 of the necropolis of La Joya (Huelva) from the 7th century BC (Quesada 1994), whose oriental attribution is undeniable. For all these reasons, we rule out the hypothesis of the chariot's introduction through an inland route that crossed the Pyrenees (Fernández and Olmos 1986; Celestino and Salgado 2011, 431-432) and we consider the motif of oriental origin (Bendala 1977; Blázquez 1986).

Nevertheless, we have to underline another noteworthy factor related to its design. Always from a mixed-top down projection, the two draught animals, the box,

Figure 2. Distribution map of stelae with depictions of chariots.

Figure 3. Distribution map of stelae with depictions of mirrors.

the wheels, and the yokes are represented as a whole, unlike other representations of chariots in the Mediterranean basin, where they appear in profile. This characteristic leads us to think that the chariot was integrated by the local elite as a symbol of ostentation, but through a graphic reinterpretation that does not pay attention to Mediterranean forms of representation. This contradicts the theory of A. Mederos (2008) about the spread of the chariot through the distribution during the «pre-colonial» period in the south of the Iberian Peninsula, for example through Mycenaean craters that included chariots in their iconography. Likewise, the arrangement of two wheels suggests their identification as chariots for parades or war (Quesada 1997), which would reinforce their consideration as a status attribute.

2.2 Mirrors

The mirror is the most common imported object in stelae representations, being widely distributed from the Guadalquivir valley to the present-day northern part of Portugal at the Spanish border (Figure 3). Therefore, they do not appear to be regional occurrences. However, the representations do not coincide with what is reflected in the material record, where mirrors are scarcely documented.

Nevertheless, this type of bronze artefact is well attested in the Balearic Islands: at the sites of Lloseta and Son Julià in Mallorca, Barranc d'Algendar, and Cova des Mussol in Menorca. Delibes, Rovira and Fernández-Miranda (1988, 129) point out that these objects in the Balearic archipelago have a special grip and fastening system, without parallels outside the islands, and propose a chronology for these pieces from the beginning of the 1st millennium BC. It could be maintained that the Balearic mirrors were local productions with no connections to the Sardinian examples, with which they have been compared on several occasions, but whose characteristic openwork handles have nothing to do with the Balearic counterparts (Guerrero 2004, 96). Furthermore, the metals for their production would have been mostly obtained from ores from nearby areas such as Menorca and, less probably, southern France (Llul, Perelló and Calvo 2022). Moreover, these objects also show the presence of contacts with regions outside the Balearic archipelago, due to the presence and introduction of new types of bronze objects, for example, swords and mirrors, and technological innovations hitherto unknown in the Balearic Islands (Perelló, Llull and Calvo 2023).

The only example that has been documented in the archaeological record on the Iberian Peninsula is the mirror with an ivory handle from tomb 17 at La Joya (Garrido and Orta 1978, 100, fig. 60) and within a context that is of eminently oriental character and influenced by the settlement of Phoenician populations. This again refers to the Mediterranean origin of these utensils when they arrived on the Iberian Peninsula.

2.3 Combs

Combs are objects with a long persistence, having been found in the Iberian Peninsula since the Neolithic period, when they made with bone, wood, or ivory (Castro 1988; Mata *et al.* 2017 with bibliography). During the 1st millennium BC they are documented in the archaeological record from south of the Tagus basin, and both on the Atlantic and Mediterranean façades (Blasco 2022 with bibliography), however they are scarce objects.

On the other hand, if we check the distribution of the motif on the stelae, we can see that it is highly concentrated in the Zújar and Guadalquivir basins, with only four examples appearing outside these areas. It should be noted

Figure 4. Distribution map of stelae with depictions of combs.

Figure 5. Distribution map of stelae with depictions of lyres.

that the high concentration in the Middle Guadalquivir coincides with the dispersion of the Early Iron Age bone and ivory combs (Aubet 1979; 1980; 1981-1982; Le Maux 2006). On the other hand, there is a gap in the material record from the last comb securely dated to the end of the 10th century BC in the necropolis of Roça do Casal do Meio (Cardoso 2004, 216-220; Vilaça 2008, 396), to their occurrence in Phoenician settlements, where they start to be found persistently from the 8th century BC onwards (Mata *et al.* 2017, 120). Hence, the representations could not be considered as a defining chronological argument, as both dates would fit respectively within the proposals of an earlier (Mederos and Harrison 1996) as well as a later (Celestino and Salgado 2011) chronology for the stelae.

In any case, as the comb is a motif characteristic for the southern stelae (Figure 4), we propose that the concentration of its representations in the middle Guadalquivir Valley and the Zújar Valley must be linked to the self-representation programme that the inland communities developed as a result of their contacts with Phoenician agents from the 8th century BC onwards. In this sense, although the comb was a well-known implement on the Iberian Peninsula, examples following oriental models were added to the list of exogenous elements that local elites adopted as objects that were prized for their exoticism. This can be deduced from their proliferation in the form of trousseaus in the necropolises of the southwest (Almagro-Gorbea 2008). We therefore consider it very likely that these are the same combs that appear on the stelae.

2.4 Lyres

Regarding this motif on the stelae, in-depth studies of musical instruments are scarce when compared with other represented elements (Bendala 1977; Blázquez 1983; Mederos 1996; Adiego 2020). For this reason, we offer new insights into their distribution and chronology in this paper. The works carried out by M. Bendala (1977) and J. M. Blázquez (1983) only included the lyres represented on the stelae of Luna (Zaragoza) and Zarza Capilla (Badajoz), whose disparate location made it difficult to make assertions about the dispersion of the motif. However, the representation of these instruments was used by both authors to support their theses about the colonisation processes that took place in the Iberian Peninsula. Accordingly, based on their parallels in the material record, Bendala (1977: 200) linked the lyres represented on the stelae to the arrival of Greeks from the Geometric period on the Iberian coast, while Blázquez (1983: 216) attributed them to Phoenician colonisation.

Later, A. Mederos (1996: 120-122) proposes a re-reading of the lyres according to the represented number of the strings. He argues that, following the evolution of these instruments in the eastern Mediterranean, a high number of strings is an archaising feature, and that they should therefore be dated to between the 14th and 13th centuries BC, in line with the *pistilliforme*-shaped swords that are documented on some stelae. However, the author himself acknowledges that the lyres from the Geometric Period (ca. 10th to 8th centuries BC) would be influenced by the Assyrian and Babylonian ones, again with a greater number of strings (Mederos, 1996: 121-122). This would indicate that a high number of strings does not imply an earlier date.

In our opinion, the basis of all three arguments, that is to say, the search for parallels in the material record to provide a chronology for the representations on the stelae, is weak, given the marked schematic nature of the carved motifs and the scarcity of archaeologically documented examples to date. In many of them, the shape of the musical instrument can only be guessed, with the sound box and

the taut strings being distinguishable, so that it could even be debated whether they are lyres or zithers. In any case, their presence on the stelae (Figure 5) could be regarded as a proof of contacts with populations of eastern origin settling in the South of the Iberian Peninsula, which shall once again be our main chronological indicator.

3. Stelae and Mediterranean trade. Proposals for the beginning of a phenomenon

Currently, 89 of the so far more than 160 catalogued stelae, or almost 54%, show representations of imported elements from Mediterranean origins. Moreover, as has already been pointed out by other researchers (Galán 1993; Celestino and Salgado 2011, 428-431; Celestino and Paniego 2021), a clear concentration of this motif composition on stelae is observed in the areas of the Zújar River, a tributary of the Guadiana, and the Middle Guadalquivir, with certain groupings detected along the middle valley of the Tagus (Figure 1).

However, these observations are the result of a general overview of the distribution of the stelae, which does not allow us to examine in depth either the mode of representation, the frequency of appearance, or the patterns of concentration of Mediterranean imports on these monuments. For this reason, we have considered it of interest to individualise and characterise these representations in search of a better perspective, which would allow us to understand how the exchange networks in the inland of the peninsula might have functioned.

As mentioned above, the objects of Mediterranean origin chosen for analysis in this contribution are the chariots, combs, mirrors, and lyres. The selection of these four imported groups of items and not others is mainly due to two criteria. The first lies in the cognitive, social, and political change that the introduction of prestigious objects of Mediterranean origin into the repertoire represented must have represented. According to the typological evolution postulated by S. Celestino, in addition to the characteristic attributes of the warrior, such as his weapons, objects dedicated to other spheres began to appear on the stelae, which were linked to the display of aristocratic status in the Mediterranean world. The inclusion of the chariot within the warrior's paraphernalia could be expected in the composition, but those objects dedicated to personal care and aesthetics, such as mirrors and combs, or the artistic sphere, such as lyres, denote the insertion in these inland communities of Mediterranean values and tastes, which are re-interpreted by local societies and represented as symbols of rank, or prestige goods. In our opinion, such a phenomenon must have taken place after intense and constant interactions between the local chiefdoms and the oriental agents or those of oriental heritage settled in the Iberian Peninsula.

The second criterion has been based upon the fact that they are elements that are not omnipresent on most of the stelae, as it is the case with shields, whose provenance has been another subject of extensive debate (Blázquez 1986; 1990; Bendala 1987; Celestino 2001; see Vilaça and Bottaini, this volume), swords, and spears. Therefore, imports can act as diacritical elements and serve as a guide to detect the possible preferences for particular objects and the intensity of contact with communities of oriental origin depending on whether or not they are concentrated in the same area. Likewise, their characteristics make them relatively easy to identify in the representations, despite their schematic nature (*contra* Harrison 2004). This fact facilitates their classification, minimising the risk of biasing the sample by asserting which stelae have representation of imports and which do not.

In this sense, the appearance of imports of Mediterranean origin represented on the stelae makes them of great interest, as they constitute one of the few pieces of evidence available to document the change in the commercial focus that took place in the transition between the Late Bronze Age and the Early Iron Age, oscillating from the Atlantic to the Mediterranean circuit (Botto 2013).

The stelae with imports constitute a key element for the reconstruction of the historical discourse that combines with the archaeological record during a period in which very complex processes took place, such as the 8th-6th centuries BC. Thus, they would be the reflection of interactions between societies of Atlantic heritage and influence, which could be classified as still immersed in the Late Bronze Age, inhabiting the interior of the peninsula, and communities belonging to the Early Iron Age with Mediterranean roots, generically called «Phoenicians», who settled on the coasts and began to penetrate inland territories (Barceló 1992; Celestino 2001). This coexistence would lead to the integration of these groups of Eastern origin into local exchange circuits that allowed the circulation of goods, ideas, and people (Aubet 1995, 148). A mixed culture would emerge from their settlements and the hybridisation with local communities of the Iberian southwest that we call Tartessus, approximately during the 8th-6th centuries BC (Celestino and Rodríguez 2017, with bibliography). In turn, the inland groups would maintain their exchange networks with the populations of the northern areas, with a redistribution of the imported elements acquired on the coasts that would lead to their insertion and reinterpretation within their system of values (Sherrat and Sherrat 1991).

In this sense, if we consider their distribution, it is an indisputable fact that stelae with or without representations

of imports are an eminently inland phenomenon, since only two have been documented on the coastline, one in Utrera (Seville, Spain), next to what then was the *Lacus Ligustinus* in the current Lower Guadalquivir, and another in Vila do Bispo (Algarve, Portugal) (Celestino and Paniego in press). This fact allows us to conceive their production as typical cultural markers of the groups that inhabited the inland areas from the Duero basin to the middle basin of the Guadalquivir. For this reason, we take them as a small window through which to look out and discern, albeit superficially, how the elites of these populations – with whom the Phoenicians and later the Tartessians must have been in contact – were constituted.

3.1 The «North-East Stelae» and the Mediterranean Routes

Although the stelae represent a localized phenomenon of the communities of the Iberian Peninsula, the depiction of exogenous objects on them implies the movement of these objects and the people who carried them. This fact has led to the reconstruction of various routes along which the practice of carving the stelae and the elements represented on them must have circulated.

In this respect, although most of the stelae have been documented in the western half of the Peninsula, we must not forget there are three exemplars in the Gulf of Lyon (France) and one in the Ebro basin, in the province of Zaragoza. The presence of these specimens might cause some discomfort, as they fall outside what we might consider the core area of dispersion of the stelae, and thus their explanation is problematic. This has given rise to hypotheses which are difficult to verify and attempt to explain their presence in the Northeast and their link with the processes occurring in the Southwest, but they suffer from the lack of conclusive data to back them up.

Before presenting these hypotheses, it seems necessary to introduce the publications that are focused on trans-Mediterranean connections during the Late Bronze Age and have been the foundation of these hypotheses concerning the distribution of the stelae. Firstly, the research of M. Botto (2004-2005; 2013) has identified two possible long-ditance routes. On the one hand, the «cabotage route», between Sardinia and the Iberian Peninsula, which would link Corsica and Sardinia with the coast of Latium, continuing along the Italian coastline to the mouth of the Rhone in the Gulf of Leon, where it would branch off into an inland route along the Iberian peninsula through the Northern Meseta to the mouth of the Tagus, and a maritime route that would go around the entire Peninsula by cabotage, passing through the Strait of Gibraltar and reaching the mouth of the Tagus. On the other hand, there would be the «high route», which would link Sardinia with the southeast coast of the Iberian Peninsula via the Balearic Islands, following a route on the high seas.

Secondly, and contradicting some of Botto's ideas, the work of V. Guerrero (2004; 2006) has focused on disproving the supposed ease of traveling from Sardinia to the Balearic Islands as this route crosses one of the great visual deserts of the Mediterranean, with no possible stopovers or geographical references to guide the navigators. According to the author, the navigation techniques of the Sardinian communities and the Iberian Peninsula during the transition between the Late Bronze Age and Early Iron Age would not have been sophisticated enough to ensure a high-altitude route, even though astronomical orientation was already known at the beginning of the 1st millennium BC in the Eastern Mediterranean. For this reason, the main circuit would have been structured through cabotage.

Guerrero (2004, 95-97) proposed as the most probable route the one that would connect the Gulf of Lyon with the Balearic Islands and these with the southeastern coasts of the Iberian Peninsula, and vice versa. This author rules out the role of the Balearic Islands as a bridge between the Iberian Peninsula and the central Mediterranean. In his opinion, the role of the Balearic Islands is closer to that of a port of call for short crossings and a receiver of ships coming from the Iberian coasts. However, the latest research points to direct exchange relations between Sardinia and the Iberian Peninsula from the Late Bronze Age onwards (Araque 2023, 13-15 with bibliography), so perhaps we should reconsider the nautical capabilities of the western Mediterranean communities.

In summary, Celestino based his hypothesis about the distribution of the stelae on the works of Botto and Guerrero Ayuso (2008a, 114; Celestino and Salgado 2011, 427), which suggested an opening of trade between the Atlantic and the Mediterranean through the Meseta and the eastern Pyrenees in the last phases of the Late Bronze Age. This process would be parallel in time to the trade contacts that would be consolidated and developed by sea through the central Mediterranean and Huelva within a «pre-colonial» stage (González de Canales, Llompart and Serrano 2004; Mederos 1996; 2008) whose functioning is difficult to characterise.

The representation of Mediterranean imports, as well as the presence of stelae in the Ebro basin and the vicinity of the Gulf of Lyon is, according to Celestino, due to the opening of a trade route that connected the northeast of the Iberian Peninsula with the Balearic Islands on one of its branches and, on the other, with the Languedoc region and the Italian coast. Thus, it points to the existence of an inland Mediterranean trade that would open a connection route from the Gulf of Lyon to the southwest, crossing the

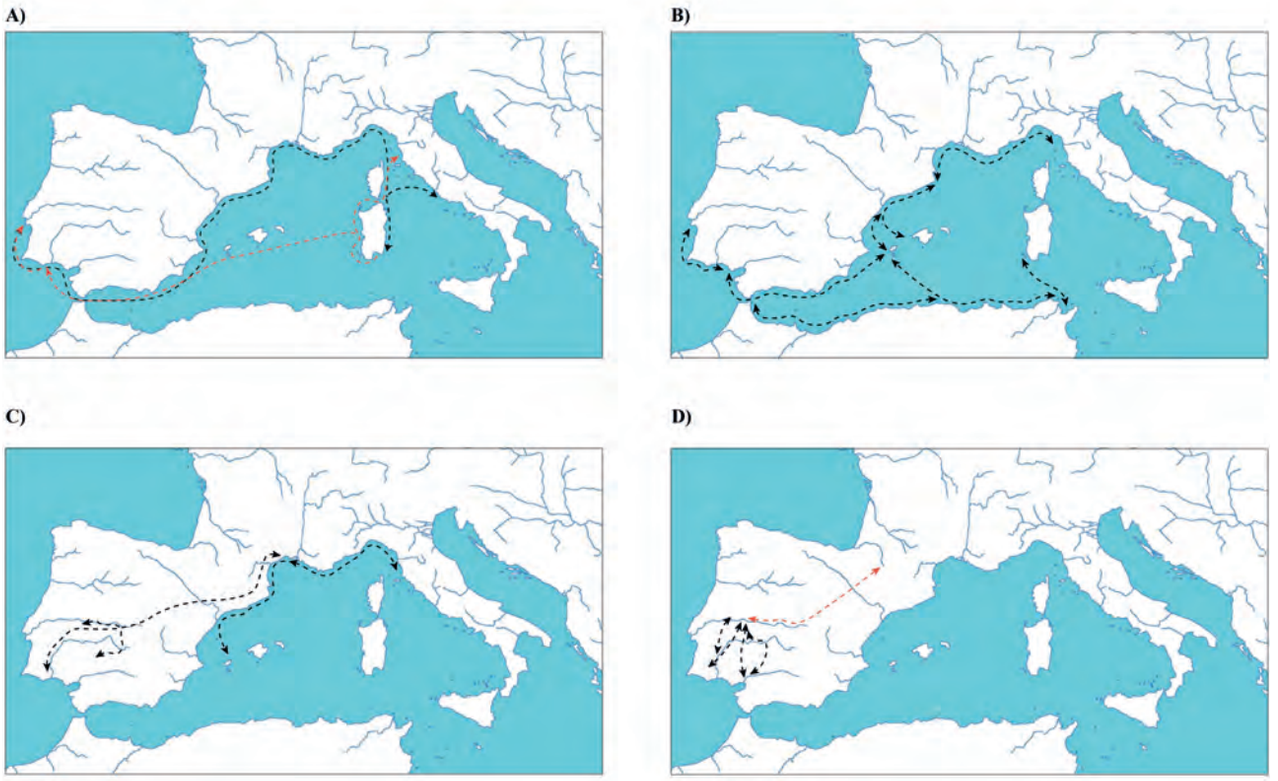

Figure 6. A) Proposal after Botto (2013, 198, fig.1; 199, fig. 2). B) Proposal after Guerrero Ayuso (2004, 133, fig. 5B). C) Proposal after Celestino (2008a, 114). D) Proposal after Ruíz-Gálvez and Galán (1991, 266, fig. 4).

entire Iberian Peninsula (Celestino and López-Ruiz 2020, 215). Furthermore, this proposal would allow us to understand the establishment, sometime later, of two foci of colonisation: the one located in the South of the Iberian Peninsula dominated by the Phoenicians; and the later focus of the Catalan coast, and Languedoc, dominated by the Greek presence (Celestino 2008a). A similar option was proposed by M. Ruíz-Gálvez and E. Galán (1991), tracing a route that would go up the Tagus and through the Jabalón River and would also reach the Ebro basin.

However, the problem with such hypotheses lies in elaborating a whole discourse around a route whose exceptional traces are so few that they do not provide sufficient argumentative basis to reconstruct a route as such, since the very term «route» alludes to a path established in space and concurred in time, i.e. of a certain intensity and regularity. Similarly, linking the stelae phenomenon with a 'pre-colonial stage' (Mederos, 1996; 2008) is also problematic. The scarce presence and limited cultural influence of these imported elements in Iberian societies during the pre-colonial period makes us doubt their significance before the Phoenician settlement and leads us to consider them as episodic testimonies of journeys before the palpable inclusion of the Iberian Peninsula in the Mediterranean trade circuit (Vilaça 2008; Celestino and López-Ruiz 2020, 199). Moreover, the reconstruction of the pre-colonial period based on the evidence documented in the archaeological record is problematic and seems to include the arrival of only a few imported materials from the Eastern Mediterranean between the 10th and 9th centuries BC. In this respect, we advocate caution and discard the idea of a route crossing the entire Iberian Peninsula in a South-west-Northeast direction, with the entailed logistic and orographic difficulties, as well as the inclusion of the Iberian Peninsula in the Mediterranean circuit during the 'pre-colonial' period.

Therefore, it is preferable for now to regard the finds of stelae from the Ebro basin and the Gulf of Lyon as exceptions, until the archaeological record and research provide us with new data that allow for a solid explanation concerning their locations and their link with a phenomenon that was much more characteristic of the inland communities of the western half of the Iberian Peninsula.

3.2 The stelae of the West. Between the Atlantic and Mediterranean routes

For its part, the location of the main concentration of the stelae in the West of the Peninsula has been explained through their inclusion in two cultural and commercial circuits. Thus, the beginning of the stelae phenomenon, where the basic stelae would be inserted, has been linked to the Atlantic world, strongly interconnected by the so-called «route of the Cassiterides» or «tin route» established dur-

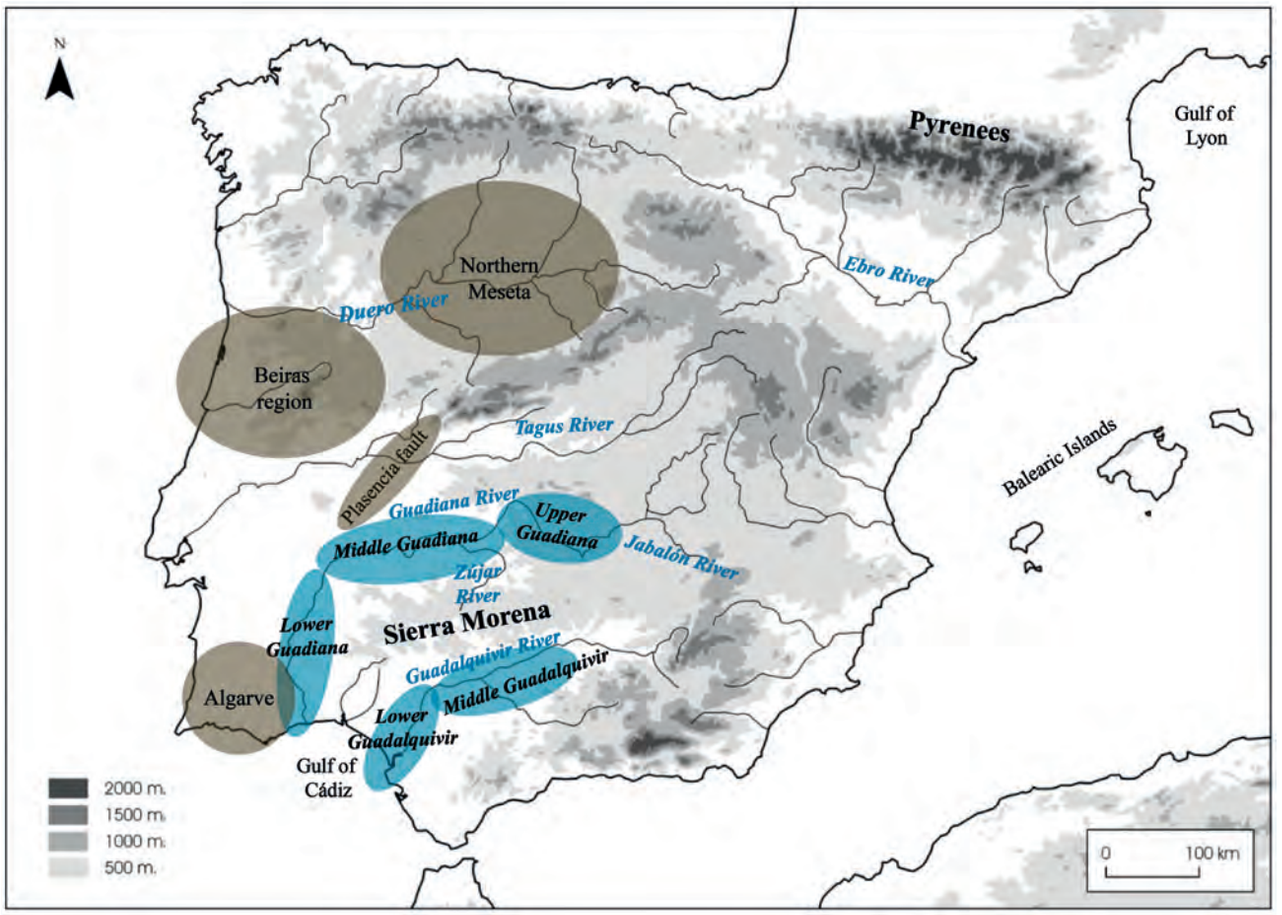

Figure 7. Map of the main geographical features and regions mentioned in the text.

ing the Late Bronze Age (Celestino, 2001; 2008a). This route connected the entire Atlantic peninsular portion with the Northwest coast of France and the British Isles, as shown by the analogies in the archaeological record of some territories and others in terms of metallurgical work (Araque 2023; Ferrer 2019Ruiz-Gálvez 1991; 1993; Ruíz-Gálvez and Galán 1991). The main motivation for establishing this route was the wealth of tin and gold concentrated from the middle Tagus basin to the Northwest of the Iberian Peninsula (Pellicer 2000, 94-97).

This commercial circuit would have expressed the connectivity of the Atlantic world in which the basic stelae would emerge, connecting the tradition of iconographic manifestations on stone supports and the conception of weapons as status symbols among the Atlantic cultures (Celestino and Salgado 2011, 420-421). On the other hand, the appearance of Mediterranean imports on the so-called 'southern stelae' has been interpreted as a result of the inclusion of the south-western territory in the Mediterranean trade circuit following Phoenician colonisation as early as the beginning of the Iron Age. This is not the place to develop all the issues raised by the question of colonisation in the Iberian Peninsula, as the bibliography is extensive and the debate is still raging today. For this reason, we will only make a brief characterisation of the process to contextualise our discourse. Therefore, we consider it necessary to clarify the periodisation of the events reconstructed here, with a first stage of contact between the Phoenician and indigenous groups at the end of the 9th century and during the 8th century BC, from where the Tartessian communities emerged through coexistence and hybridisation processes, which in turn would continue contacts and interactions both with Phoenician agents on the coasts and with inland groups, some of which would end up being included in the Tartessian populations, as in the case of the Guadiana communities of the 8th-6th centuries BC- (Celestino and Rodríguez 2017).

The Phoenicians, after verifying the potential of the territory, especially the rich silver mines of Huelva, had to settle and initiate relationships with the local populations to access these resources (Aubet 1994; Alvar 2008). The knowledge of the terrain and the need for manpower to establish a system of exploitation of the environment on the large scale that was detected in the archaeological record could not have been achieved by the Phoenicians alone, but rather required a substantial contribution from the indigenous population (Celestino 2008b; Celestino and López Ruiz 2020).

In this respect, it is worth noting the often overlooked pessimistic proposal of F. J. Moreno Arrastio (1999), in

which he maintains that such contributions were made through the sale of slaves by the ruling groups of the inland regions to the Phoenicians settlers. In any case, this would not be the only way to explain the demographic boom experienced in the Southwest of the Iberian Peninsula, as migratory population movements towards the Guadalquivir have been considered on several occasions (Barceló 1989; Belén and Escacena 1995; Celestino 2008b). Although the enrichment of the local elites through the supply of labour for mining and agricultural exploitations must remain hypothetical, this is a possibility that must be kept in mind.

Finally, the groups of Eastern origin would gradually be included in the exchange circuits of the local population to gain indirect access to mining and the metallic riches of the Upper Guadiana (Zarzalejos, Esteban and Hevia 2011; Zarzalejos 2023; Miguel-Naranjo and Morales Hervás 2022) and the middle valley of the Tagus, which provided alluvial gold, silver galenas, and tin deposits, and were exploited since the Chalcolithic (Cardoso 1995, 22).

Such contacts led to the integration of Mediterranean imports into the spheres of the local elites, who reinterpreted and adapted them to their customs of self-representation, including their appearance in the engravings on the stelae. This would be the genesis of the southern stelae (Celestino and Salgado 2011 with bibliography).

4. Inland exchange systems in the light of the latest research

After analysing the elements of importation represented on the stelae, it seems necessary to give a unified reading of all the arguments put forward here. Thus, we detect two patterns of interest in the cases discussed. Firstly, the proliferation of these objects in the archaeological record, and therefore on the stelae, is the result of the Phoenician colonisation of the Southwest of the Iberian Peninsula, which was the catalyst that stimulated the inclusion of these imports in the repertoires of the local populations as markers of status.

Secondly, the dispersion of representations of chariots, combs, and lyres does not go beyond the limits of the Tagus Valley. However, only mirrors are documented as far as the northwestern regions. This fact would highlight the incorporation of chariots, combs, and musical instruments into the list of objects linked to the display of the status of local elites. They would be distributed and incorporated into the repertoires of the communities settled in territories bordering the so-called «Tartessian nucleus» due to their more intense and constant contact with the populations of eastern heritage in the South of the Iberian Peninsula and, therefore, also with their technical knowledge and treatment of materials. This would explain their presence beyond the Tagus as a symbolic frontier of this eastern influence.

In this respect, we consider it necessary to bring up the latest research in experimental archaeology (Araque *et al.*, 2023), which has shown that most of the southern stelae, by which we mean those in the Guadiana and Guadalquivir valleys, must have been carved with hardened steel chisels, since bronze chisels or lithic tools would not be able to carve the material of those stelae made with quartzite or silicate quartz-arenite in the same way that is found in the record. However, it should be noted that this circumstance does not apply to the stelae the North of the Tagus, which are mostly made of granites, which are softer and easier to carve with lithic tools (see Araque *et al.*, this volume; Araque *et al.*, 2023: 25).

This relevant discovery appears, in our opinion, to highlight a fact that has been intuited by several researchers but is disagreed by others: the stelae phenomenon belongs to the Iron Age. This period began on the Iberian Peninsula with the arrival and settlement of groups from the eastern Mediterranean. The Phoenician colonisation catalysed several processes that began with their establishment and consequent contact, to varying degrees, with the local communities. These included the generalisation of ironworking, which was established on the Iberian Peninsula at least at the end of the 9th century BC, as demonstrated by the early contexts recently documented in the south of the peninsula (Gomá, 2018: 354; Becerra, 2023: 211).

Some of the oldest iron objects in the Iberian Peninsula are documented in the Portuguese region of the Beiras, dated by C14 to between the 12th and 10th centuries BC (Vilaça 2006). However, they seem to be part of a process of experimentation with iron by the indigenous population, as the metal received different treatments with varying results as a result of rudimentary production, giving rise to soft irons whose hardness would not exceed that of bronze (Vilaça 2004; 2006, 95-98; Mederos 2009).

This leads us to consider this metallurgical phenomenon in the central Portuguese territory as a unique case in which, whether the raw material was imported from pre-colonial agents (Almagro-Gorbea 1993, 88-90), or whether it was an initiative of the indigenous population itself, ironworking was experimented with. Nevertheless, its adoption for the production of tools ended up without being extended to other areas, resulting in a temporary invention that was gradually lost over time. It was generalised by the Phoenician colonisers on the Atlantic coast during the 8th century BC (Vilaça 2006; Arruda 2005). This would therefore be an isolated case, while the rest of the iron objects documented in the Iberian Peninsula, specifically in the Northern Meseta and the southeast, are dated between the

10th and 9th centuries BC and seem to belong to a different phenomenon (Almagro-Gorbea 1993).

A similar phenomenon could be represented from the deposit from the bottom of a hut from El Berrueco (Salamanca), dated to the 9th century BC, where the experimentation with iron seems to have taken place once again, imitating forms typically made of bronze and finding objects made from iron and bronze. However, we do not know the quality of the steel alloys (Almagro-Gorbea 1993, 83). In the case of the south-eastern area, the inclusion of iron is linked to its consideration as a semi-precious and exotic material, as is the case with the treasure from Villena (Alicante), which could be interpreted as a Mediterranean import resulting from these pre-colonial journeys.

On the other hand, the bimetallism of bronze and iron is a constant feature in the Iberian Peninsula, which suggests a time of experimentation with this material that does not seem to have had a prolonged development over time. It is impossible to make more in-depth assessments as the record is limited, with poor preservation and contexts that are often not very eloquent or reliable (Álvarez-Sanchís, Lorrio and Ruiz 2016).

Given the limited scope of pre-colonial iron metallurgy, there is no doubt that it became widespread following the Phoenician colonisation, including its subsequent dispersion within the inland populations. Thus, the archaeological record of recent years has shown that the introduction of ironworking between the 9th-8th centuries BC took place in areas closely linked to Phoenician colonisation such as Huelva, Acinipo (Ronda, Málaga) and Morro de Mezquitilla (Vélez-Málaga, Málaga) (Gomá 2018, 354; Suárez, Becerra and Sánchez, 2023).

This technological innovation would provide local communities with the necessary material, that is to say, hardened steel chisels, to carve the hard-rock stelae. Proof of this process would be the chisel found in Rocha do Vigio, dated by C14 to 900-770 cal. BC (Mataloto, Martins and Soares 2013; Araque *et al.* 2023, 7-8). This site is located on the banks of the lower section of the Guadiana Valley, in the immediate territory of the Tartessian nucleus and along the N-S route that connected the area of the Gulf of Cádiz with the interior. This route was of great importance during the Late Bronze Age and would also be key during the whole of the Iron Age, which is why we propose it as one main route of communication on the Atlantic side of the peninsula during this period. Therefore, knowledge of ironworking may have reached this enclave thanks to contact with the Oriental communities recently established on the Iberian Peninsula. Thus, this fact provides us with a *post-quem* date for those stelae from the Zújar valley that are made of quartzite and quartz-arenite between the end of the 10th and beginning of the 8th century (see Ferreiro Mählmann *et al.* and Araque Gonzalez *et al.*, this volume Araque *et al.*, 2023).

Finally, we interpret the processes that we have been trying to reconstruct between the end of the 9th and the 6th century BC in the way that the southern stelae were developed in this timespan, most of them with compositions showing all the imported objectsthat have been studied here. Thus, we consider these stelae to be the result of a trend towards self-representation of status by the elites of the populations located between the Guadalquivir and Tagus Valleys as a result of the stimulus of the Tartessian nucleus.

In this respect, it should be noted that the areas with concentrations of stelae do not coincide with the main Tartessian *nuclei* (Celestino 2001), neither in the Guadalquivir nor in the Guadiana area, but are located in the peripheral areas and on the connecting routes between both valleys. Although these would be those regions where indigenous communities in contact with the eastern Mediterranean people lived, we do not have a proper knowledge of the material record that would characterise these inland populations.

These communities would already be endowed with a certain social complexity, which was further accentuated by their interaction with agents of eastern heritage. This complexity would be reflected in the stelae, from which we deduce a system of exchange in which not only Mediterranean imports were introduced, adopted, and re-interpreted as status symbols, but that could have motivated the adoption of a system of weights to facilitate exchanges, as suggested by the groupings of dots represented on the stelae and interpreted as sets of weights by Celestino (2001, 181-185). These motifs are concentrated exclusively in the area of the Zújar River, one of the main passes for communication between the Guadalquivir and the Guadiana through the Sierra Morena mountains. Such representations could allude to the importance of the commercial factor in the stelae, which has so far only been hinted at (Celestino 2001; Celestino and Paniego 2021). Therefore, they could represent an aspect of commercial control within these ruling groups. However, this proposal must be considered as a hypothesis given the impossibility of its reliable verification.

We will not enter here into the discussion about the ultimate character of the stelae, in the sense of possible links to the funerary world (Almagro-Gorbea 1977), in their ascription as markers of territory (Ruiz-Gálvez and Galán 1991), as representations of divinities (Celestino and López-Ruiz 2006; Tejera, Fernández and Rodríguez 2006) or heroic ancestors (Díaz-Guardamino 2012; Ruiz-Gálvez 2019). However, it is interesting to delve into their role as a means of self-representation, reflecting a new system born of the interaction with the oriental population substratum.

The arrival of Phoenician agents must have changed the patterns of exchange that had existed on the Peninsula until then by introducing a new actor into the dynamics. However, we will never know to what extent. Thus, two spheres of exchange were established: one between the south-eastern population substratum and the indigenous interior; and the other between the interior communities themselves.

Certainly, a new dynamic had been established, in which the party of Eastern Mediterranean origin offered in these exchanges manufactured goods, made with techniques and from raw materials never seen before in the Iberian Peninsula, which gave them a factor of exoticism, turning them into prestige goods (Gallay 2010). It might even have been possible to transfer these prestige goods as gifts that would generate and reproduce certain social relations to achieve a stage of equality, which would give rise, for example, to political and economic agreements between the leading groups on both sides (Godelier 2000).

On the other hand, once these prestige goods were in the hands of local elites, they could in turn experience two situations: the accumulation of these goods as a symbol of distinction and power over the rest of their community and other groups, that is to say in an area of inequality; or their use as a means of establishing relations with the ruling groups of other neighbouring populations by handing them over, either as a gift or as an object of exchange valued for their exoticism (Godelier 2000; Gallay 2010).

The hierarchical nature of these inland communities seems clear from the form of self-representation that emerged with the stelae. The ruling elites of these groups sought to distinguish themselves by representing the attributes that symbolised their power, in this case, weapons and prestige goods imported from the Mediterranean basin (Almagro-Gorbea 1977). It was, therefore, a new way of expressing status.

4. Closing remarks

Throughout this contribution, we have focused on reconstructing the contact processes and consequent exchanges that reflect the appearance of Mediterranean imports on southern stelae. On a general level, although many of the stelae have not been found in situ, due to their dimensions and weight it does not seem likely that they were moved over a long distance (Díaz-Guardamino *et al.* 2019, 70; see Baptista, Araque and Ferreiro Mählmann, this volume), so the analyses of their location and their distribution remain significant.

Thus, as previously mentioned, the most discernible concentration of import representations is observed in areas of connection between territories, that is, in the passes between mountain ranges that separate the Tagus basin from the Guadiana basin, and in the Zújar basin, one of the main communication routes between the Guadalquivir and the Guadiana. Therefore, presumably, the individuals who initiated the creation of the stelae inhabited and controlled these areas of passage, establishing themselves as key agents for intra-territorial exchanges and communications.

As it has been said, the main interest of the Tartessian nucleus in the interior would have been the acquisition of metallurgical resources and labour, so that this intermediary role on the part of those individuals depicted on the stelae would have been of great importance for the connections between the interior and the coast, bringing them a certain enrichment (Celestino 2001).

Therefore, corroborated by the dispersion of archaeological material and the Mediterranean motifs on the stelae, it is possible to characterise the main routes that would have facilitated the functioning of the exchanges. However, it should be made clear that we are always referring to the general dynamics reflected in the archaeological record, as it is impossible to trace the routes.

These routes would link the area of the Gulf of Cádiz with the interior. One side would link the mouth of the Guadalquivir and its middle stretch to the Guadiana basin, using the Zújar Valley as an intermontane pass to overcome the Sierra Morena relief, which would be more permeable than previously thought (Pellicer 2000). The other side would go up the course of the Guadiana and continue along overland roads in an N-S direction that would connect with the Tagus valley through the Plasencia fault (Álvarez and Gil 1988) (Figure 8).

Therefore, we must emphasise that this would be a phenomenon typical of inland groups, especially those who inhabited the grazing areas in the foothills of the mountain ranges that separate the main river valleys and in the passes that would articulate communication between them, as other researchers have already noted (Ruiz-Gálvez and Galán 1991; Celestino and Paniego 2021).

Likewise, we can see that these routes persisted in a time of great social complexity in the Iberian Peninsula, during the transition from the Late Bronze Age to the Early Iron Age, in which the stelae emerged. The latest discoveries about the establishment of ironworking and the need for hardened steel chisels to carve the hardest rocks provide us with a *post-quem* date of the 9th century BC for the southern stelae. The link between this finding and the process of colonisation is almost irrefutable. However, these assertions apply mainly to the stelae found between the Guadalquivir and Guadiana basins and those with imports from the Tagus valley. On the other hand, the stelae in which no imported elements are represented have been interpreted as earlier, constituting the first examples of the

Figure 8. Hypothetical map of principal inland routes (as proposed by author).

stelae phenomenon. Celestino (2001, 87) has already made important observations on this issue, stating that one of the characteristics of the area to the North of the Tagus basin is that all the weapons were made with incisions without recessing the decorated surfaces, while in the Tagus area, the interior of some objects are recessed and the figures of others are outlined. These circumstances would be related to the technical factor, subordinated to the type of tool used and its carving capacities.

To this must be added a cultural factor of separation. Therefore, from the analysis of the Mediterranean imports on the stelae, it has been possible to observe a pattern that is repeated in the dispersion of the representations of all these objects, except the mirror motif: their concentration from the Guadalquivir area to the Tagus basin, its river valley constituting a kind of «frontier» as far as the inclusion of imports as an expression of status is concerned. We link this circumstance to the greater influence and interconnection of these southern territories with the Tartessian focus, whose assets of eastern origin were included, to a greater or lesser degree depending on the area, within the cultural assets of the neighbouring communities. This would explain the clear pre-eminence of panoply, with strong Atlantic roots, and the absence of imports in the northern stelae, except for mirrors.

However, given the clear chronology established for the southern stelae in the Early Iron Age, ca. 9th-6th centuries BC, we put forward in this work an idea that for the time being must remain in the realm of the hypothetical: the coetaneity of the stelae with complex compositions from the southern area and the basic ones. As we have already mentioned, the establishment of ironworking as a result of Phoenician colonisation meant the transition from the Late Bronze Age to the Iron Age for the southern communities closest to the eastern focus. However, while this process was taking place, the northern populations were still materially living in the Late Bronze Age, with Atlantic cultural sets. Thus, there would be an overlapping of stages that escapes the traditional historical division, but which seems much closer to reality. In the same time range, two different historical periods might have coexisted in neighbouring territories on the Iberian Peninsula (see Paniego, this volume). This observation does not imply the non-existence of groups of stelae that predate others. Indeed, it does open up a new trajectory for understanding the stelae that combines the interpretations of this phenomenon as a typical manifestation of the Late Bronze Age with those that integrate it into the dynamics of the Early Iron Age.

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PART II

Stelae, Land, and Stones: Landscape-Archaeological and Geo-Archaeological Analyses

CHAPTER 7

Assorted Rocks: Petrographic, mineralogical, geochemical and geo-morphological studies of the Iberian stelae

Rafael Ferreiro Mählmann, Ralph Araque Gonzalez, Enrique Merino-Martínez, Pedro Baptista and *Pablo Paniego*

Abstract

This chapter will first present the stelae and the rocks that have been used for their making from the two core study areas of this project, namely the Portuguese Beira, with a focus on the Beira Interior, and the Spanish Extremadura, with a focus on the Zújar valley. The geology of both regions will be taken into consideration for the analyses. The material properties of the lithotypes, distances between stelae and rock outcrops, as well as landscape settings are considered, all of which played a role in the choices made by prehistoric artisans. The approach and results from petrological studies will be presented and the results will be discussed. This showed selective patterns for the choice of particular lithotypes for stelae. Finally, the implications of these material selections with relevance to the underlying knowledge of materials and technologies that had to be applied for rock art making in FBA-EIA Iberia will be evaluated from a geo-archaeological perspective.

Keywords: Geo-archaeology, rock art, material analyses, technology, provenance studies, Final Bronze Age, Early Iron Age.

Resumen

Este capítulo presentará en primer lugar las estelas y las rocas utilizadas para su elaboración en las dos áreas principales de estudio de este proyecto: la Beira portuguesa, centrándose en la Beira interior, y la Extremadura española, centrándose en el valle del Zújar. Se presentará la geología de ambas regiones. Se tienen en cuenta las propiedades materiales de los litotipos, las distancias entre las estelas y los afloramientos rocosos, así como la configuración del paisaje, factores todos ellos que desempeñaron un papel en las elecciones realizadas por los artesanos prehistóricos. Se presentarán el enfoque y los resultados de los estudios petrológicos y se discutirán sus resultados. Los resultados muestran patrones selectivos en la elección de determinados litotipos para las estelas. Por último, se evaluarán desde una perspectiva geoarqueológica las implicaciones de estas selecciones de materiales en relación con el conocimiento subyacente de los materiales y las tecnologías que debieron aplicarse para la elaboración de arte rupestre en la península ibérica del Bronce Final y la Primera Edad del Hierro.

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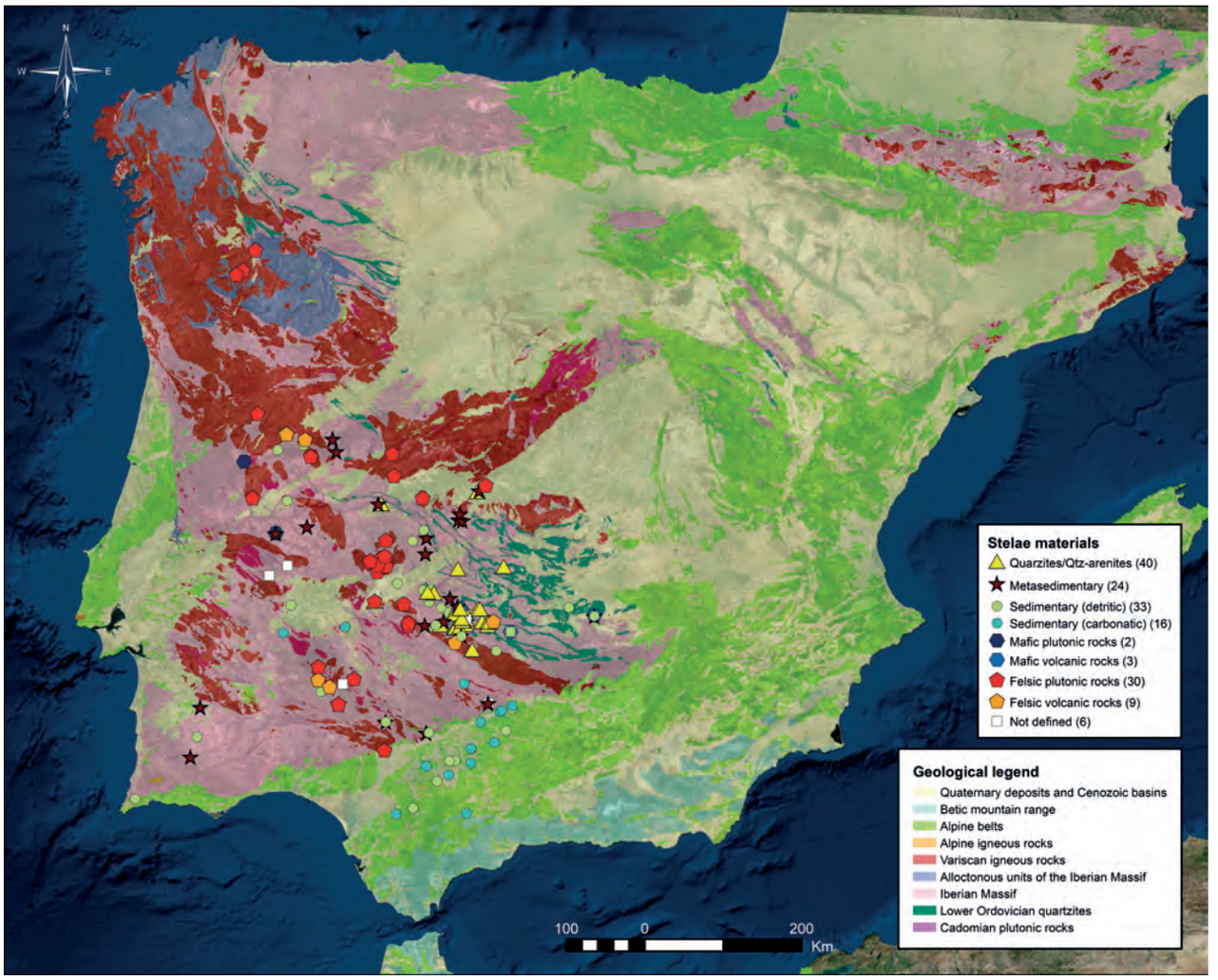

Figure 1. Simplified geological map of the Iberian Peninsula with legend, showing FBA-EIA stelae with their generalized lithotypes (Map: E. Merino-Martínez).

Palabras clave: geoarqueología, estelas, análisis de materiales, tecnología, estudios de captación de recursos, Bronce Final, Primera Edad del Hierro.

1. Introduction

The western Iberian stelae of the Final Bronze Age (FBA) and Early Iron Age (EIA), c. 1200-550 BC, are sculpted stone slabs with carvings of objects such as weapons, ornaments, mirrors, and anthropomorphic as well as zoomorphic figures (see Paniego, this volume; Celestino Pérez 2001; Díaz-Guardamino 2010). They were found all over the Iberian Peninsula, but their centre of distribution is in the western regions, comprising Portugal, Extremadura, Toledo (Castile La Mancha) and Andalusia (Fig. 1). Their height ranges from 35-270 cm, width from 30-60 cm, thickness from 10-30 cm, and their weight from below 50 kg up to around 1.5 tons. Despite the many quotations of these stelae as representative archaeological finds of south-western Iberian prehistory, petrographic data are extremely rare and have only been provided for a small group of six stelae from Toledo (Merino Martínez *et al.* 2020) and three examples from Andalusia (Díaz-Guardamino *et al.* 2019; 2020; Rivera Jiménez *et al.* 2021). These analysed stelae were mostly found nearby local outcrops, where the rocks had been sourced. However, the first geo-archaeological studies revealed cases where the desirable rock for a stela might have been transported over ca. 40 km (Merino Martínez *(* 2020, 16).

Most notably, the problem that more than 50 % of all stelae have been carved into the hardest materials that could be used for rock art, for example granite rocks and silicate quartz arenites, has only rarely been addressed. In addition, research on the tools and technologies used in their production is almost non-existent (see Araque Gonzalez 2018, 187-189). Within this approach, the stelae will be studied as multifaceted image media by considering the depictions together with the actual rock materials that were used to screen the symbolic information, and their positioning in the landscape (see Baptista (, this volume) as an inseparable cognitive unit.

The first step taken for this geo-archaeological study was the systematic petrographic analysis of 15 stelae and 44 suspected rock outcrops in Portugal, which resulted in the determination of the provenance of ten stelae. In Spain, 24 stelae were analysed with mesoscopy and seven with invasive analyses. Subsequently, four outcrops along the Zújar river were sampled, and consequently, the provenance of the rocks used for four stelae could be determined, which might be applicable in the future to other monuments from this same area (see also Araque Gonzalez *(* 2023; in press). The hypotheses that hard to extremely hard rocks have been preferentially used for stelae in at least two regions, namely the Portuguese Beira Interior, where leucocratic granitoids and hard sedimentary rocks could be determined, and in the Zújar valley in Spanish Extremadura, where silicate quartz arenites prevailed. The first results from these analyses will be presented in this chapter. The fieldwork at this stage was concentrated in the Beira Interior in Portugal, therefore the discussion of this study area is more extensive.

2. What constitutes a hard rock?

The widely used Mohs hardness scale for minerals, ranging from 1 (very soft talc) to 10 (hard diamond), actually only indicates the hardness of the homogeneous mineral (see also Araque Gonzalez *et al.*, this volume). Several variables, most importantly rock microstructure, determine the approximate hardness of rocks that are composed of various minerals, for example granitoids as well as most sedimentary and metamorphic rocks used for the stelae. The hardness is based on the mineral bond, which depends on the idiomorphism, the matrix or the cements between the coarser minerals, the mineral interlocking, in particular in how intergrowth, cohesiveness, and whether cleavage, layering, veining, flow structure in igneous rocks, fabric banding, etc. occur.

Granites with >50% quartz (Mohs hardness 7) are usually very hard, >30% quartz hard, >50% feldspar (Mohs hardness 6) medium hard, >30% mica (Mohs hardness 2.5-3) rather soft, and with >50% feldspar and >30% mica very soft. If the grains are polygonal and even-grained, the granite is brittle (even with >30% quartz), as well as when the feldspar is porphyritic and coarse-grained. If the mineral interlocking is lobate-shaped or amoeboid, the granite is stable and hard (even if it contains >50% feldspar or >30% mica). Moreover, when the mica is intergrown with the quartz, the high fissile mica (or layered silicates) is coated as an inclusion, and the granite becomes very hard. Finally, uneven fine-grain sizes and isotropy might increase the hardness of granitoids. If the softer feldspars constitute the embedding frame for the quartz, they can be easily worked into filigree shapes for sculpture or carved with precise lines. However, quartz accumulations or porphyry feldspars and veins might break off and result in irregular edges of the carved lines (see section 6.).

Sedimentary rocks, for example arenites, might consist of 99 % quartz (Mohs hardness 7), however if the quartz grains are embedded in clay, they can be separated with a fingernail, and a carving could be scratched into them with a pointed wooden stick. Contrariwise, if the quartz grains are embedded into a silica gel, resulting in a silicate matrix, this results in a very hard rock composition, and in this case the total rock would have a hardness of 7 on the Mohs scale. The silicate quartz cement can lead to a comparable strength and hardness of a metamorphic isotropic quartzite grain structure (interlocking of two recrystallized quartz grains). As a result, the grains of quartz-arenites and quartz-cemented arenites are so tightly cemented that the rock breaks across the grains rather than around them (Aston, Harrell and Shaw 2000). This characterises the technical properties of silicate quartz arenite rocks that have been used for stelae in the Zújar valley, where the silicate cement has a hydrothermal and/or contact metamorphic genesis.

Finally, if a metamorphic quartzite structure was formed during orogenic metamorphism, a slaty cleavage or, more prominently, a schistosity may cause a carving failure weakness zone. Delamination along cleavage is preferentially possible and was observed on foliated arenites in the meta-sediments from the Beira Interior and on the Meimão stela in Portugal. Nonetheless, the feldspar-mica content and open porosity might make a difference as softening factor (specifically if connective). However, they remain clearly below 5 vol% in the analysed stelae with an isolated-dispersed distribution, which renders them negligible.

3. Method of Analysis

The petrographic rock determination began with mesoscopic analysis of stelae in the museums with a binocular (50x) to obtain a preliminary assessment of their lithology. In a second step, outcrops of corresponding lithotypes to this assessment were localized and sampled to clarify the provenance. Successively, minimal-invasive samples were collected, predominantly with the safest method of choice, which was core drilling (14 mm width, ca. 25 mm depth) to prepare thin sections for microscopy (16-1000x, 2000x with photographic technique). The drill-holes were subsequently restored by using the capping of the cores and epoxide, with adequate stone restoration compound, or by mixing stone dust and epoxide for a filling. In a few cases, museums only permitted the acquisition of samples with a hammer and chisel, however this is a riskier method and must be conducted with thorough precautions to not cause

fissures or uncontrolled breakage in stratified sedimentary and foliated metamorphic rocks. Moreover, this difficult-to-control method does not facilitate restauration and it must be emphasized that it should only be applied with professional surveillance (stonemason experience and petrographic expert opinion). The drill powder and/or remaining material from the thin section preparation were used for geochemical analyses with x-ray fluorescence (XRF), inductively coupled mass spectrometry (ICP-MS), X-ray diffraction on powder and clay mineral samples (XRD), Raman spectroscopy (RS), and electron microscopy for environmental scanning (ESEM).

The sampling was conducted on all stelae where this was authorized; the Museum of Badajoz, where most stelae from the Zújar valley are now located, did not permit invasive sampling, hence only mesoscopic analyses could be applied. In this context, it is important to note that very fine-grained sedimentary, metamorphic, and volcanic rocks, as well as fine grained dyke and leucocratic (white and light-coloured) granitoids, cannot be determined conclusively with mesoscopy, let alone macroscopic evaluation.

For example, the stela from Huerto de la Cava (Torrejón el Rubio) in the Museum of Cacéres had macroscopically been classified as quartzite, which was firstly thought to be correct in the mesoscopic study. However, the remaining high quartz content on the surface after weathering has proven misleading in the microscopic study. In the thin section, the layered silicates (chlorite, muscovite) and some feldspars (mainly plagioclase) were weathered away, exposing a non-representative quartz-content of ca. 90 vol% and a high micro-cavernous porosity. However, only the deeper, non-weathered layers revealed the much lower actual quartz content of ca. 45 vol%, resulting in a completely different lithology.

The problem with sometimes recommended portable XRF (pXRF) analysis is that it is a point analysis and is therefore not representative of the composition of the whole-rock. For this reason, it is necessary to carry out several analyses on each sample, depending on the grain size. In addition, some elements, such as Si, Al, K, Ca, Mg, or P, normally with "high" values in felsic (granitoid) rocks, are not well detected by pXRF, due to their fast response in a depth between 1 and 100 micrometres. Furthermore, sodium (Na) cannot be measured by this technique, and is also a common element found of granite rocks. Hence, given the erratic values for these elements, a database of granitoid rocks (or any other lithology) also analysed by pXRF would have to be available to compare, which is mostly not the case (Laperche and Lemière 2021). Additionally, the microstructures of fine-grained quartzite and silicate quartz arenites cannot be resolved by macro- or mesoscopic studies. Finally, the microstructures of rocks, in the same way as in metallic objects, are not chemical potentials but physical grain relationships and thus cannot be detected by spectroscopy.

For a modal analysis, only a microscopic study of thin sections can reveal the lithotype for magmatic (plutons, dykes, and volcanic rocks; McBirney 2007) according to the Streckeisen (1976) classification (cf. Le Maître *et al.* 2007) and for sedimentary and meta-sedimentary rocks according to the Pettijohn, Potter and Siever (1972) classification. With this method, the mineral assemblage, grain size and microstructural singularities can be studied (Leeder 1988). Complementary geochemical analysis can deliver additional results (whole rock chemical singularities) on its provenance. The petrographic and geochemical determination of lithotypes followed this protocol:

1. Petrographic analyses of the stelae (mesoscopic and ideally, microscopic).

2. Determination of possible outcrops, sampling and comparison to data from stelae.

3. Geochemical analyses (XRF, ICP-MS) to clarify possible mineralogical inhomogeneity.

4. The results were used as a basis for the replication experiment (see Araque Gonzalez *et al.* this volume).

First of all, this geo-archaeological approach and the petrological re-evaluation of stelae have shown that the declared rock types in the bibliography were mostly inappropriate or vague and could now be corrected in order to guarantee scientific accuracy. In fact, none of the sedimentary and metamorphic rocks used for stelae and studied within this research was correctly classified with the former assignments in museums and earlier publications. In one case, a wrong main rock group had been assigned (for example, a meta-arkoses was thought to be a granite). Therefore, it is a desideratum for all future provenance and material studies of Iberian stelae as well as rock art in general to rely on the correct lithology.

Secondly, petrographic, and mineralogical identification revealed the precise provenance of rock outcrops for several monuments. The provenance of granitoid stelae from the Beira Interior will be discussed in section 4.2 of this chapter. Additionally, the provenance of two stelae from the Beira Interior from the Serra da Malcata could be determined by the results from sediment geologic, structural, petrographic, mineral composition, and geochemical analyses within a field study (Döbler, 2023). The provenance study of six stelae from the Zújar valley in Spain

(Capilla I, II, III, VIII, IX, X) was facilitated by the favourable natural outcrop conditions near their find spots in the Sierra de la Moraleja), allowing for a secure attribution to surrounding stratigraphic formations (Araque Gonzalez *et al.* 2023).

For the first time, in the course of this study a diagenesis thermal grade to low-grade metamorphic mapping of a field gradient was applied using clay mineral/mica and coal petrographic indices for a provenance study (cf. Krumm *et al.* 1988; Ferreiro Mählmann *et al.* 2012). Initially, the diagenetic to metamorphic grade was determined on the rocks of the stelae. Next, by applying a large sample grid in the field, isothermal gridlines were reconstructed, resulting in a two-dimensional geographic zoning of isothermal conditions. This was achieved by a decimetre gradient scale of diagenetic to metamorphic paleo-temperatures of ± 10 to 30 °C. Wherever the strike of the litho-stratigraphic formation succession crosscuts the isotherms, the area with the same thermal grade and hence the lithotypes to be looked for can be narrowed down considerably (within this case study to < 100 m^2). This approach was first applied in the BSc thesis of Timo Döbler (2023), where the respective outcrops for the two meta-sedimentary rock stelae from Fóios and Meimão could be localized.

Within a third work step, the petrographic data and the newly established lithology allowed for a systematic examination of the physical qualities of the rocks used for stelae for an application in the archaeological experiments (Araque Gonzalez *et al.*, this volume). In summary, this ongoing research has so far provided comprehensive scientific data on 52 stelae. Examples from the Portuguese Beira Interior and the Zújar and Guadiana valleys in Spanish Extremadura will be presented in greater detail in the following; for geo-archaeological data on stelae from the region of Toledo (see Merino Martínez *et al.* 2020; Pereira *et al.* this volume), and from Andalusi (see Díaz-Guardamino *et al.* 2019; 2020).

4. The stelae from the Portuguese Beira Interior and the Spanish Alta Extremadura

The FBA-EIA archaeological record from the Portuguese Beira Interior, a region located in the central interior of Portugal, comprises settlements, hoards, mining activities, as well as an important concentration of western Iberian stelae (Vilaça 1995; 2013; Osório, Baptista and Vilaça, this volume). This region finds its natural extension in the neighbouring Spanish Northern Extremadura, defining a common geo-archaeological area that was not divided by a national border in the FBA. Within this geographic contact region, the Iberian Meseta meets the Tagus valley. The northern mountain reliefs are structured by the Iberian

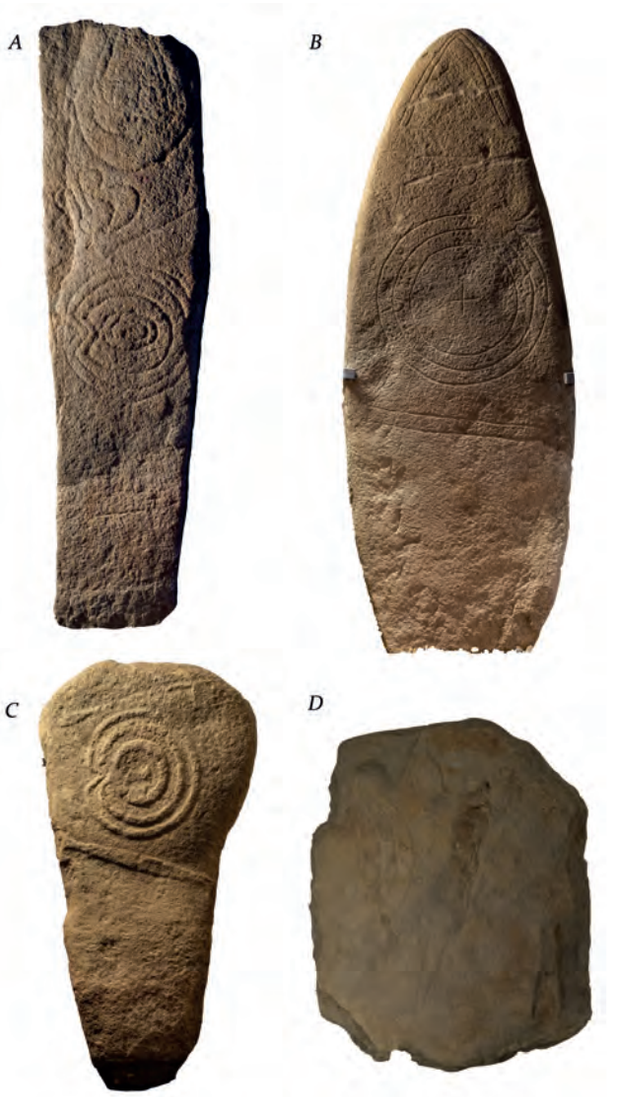

Figure 2. Stelae from the Portuguese Beira. A. Aldeia Velha (Po 09, height: 188 cm) B. Telhado (Po 08, height: 267 cm) C. Baraçal 1 (Po 01, height: 155 cm) D. Meimão (Po 26, height: 69 cm) (unscaled; Photographs: A. Felicísimo, KRAKEN Group).

Central System, represented here by the Serra da Gardunha, Serra da Estrela, Serra da Malcata / Gata and Sierra de Gredos, which give way to the southern plains, anticipating Alentejo. The Douro river basin, comprising the upper stretches of the Côa, meets the Tagus basin with its tributaries Tiétar, Alagón, Erges, Aravil, and Ponsul, which structure the territory in a NE-SW orientation.

The stelae in this territory are, in the vast majority, made with the basic format that is characterized by a motif composition of sword, shield, and spear with occasionally additional objects, for example a helmet, mirror, fibula, or comb (Fig. 2). The human figure is, apparently in tradition of the Early / Middle Bronze Age (EBA, c. 2200-1700 BC; MBA, c. 1700-1300 BC) statue menhirs (Rodríguez Corral 2018), inherent in the anthropomorphic format of the rock supports, rather than represented by the carved motifs.

The greatest concentration of the stelae in the Beira was found in the area of the Serra da Malcata / Gata, in

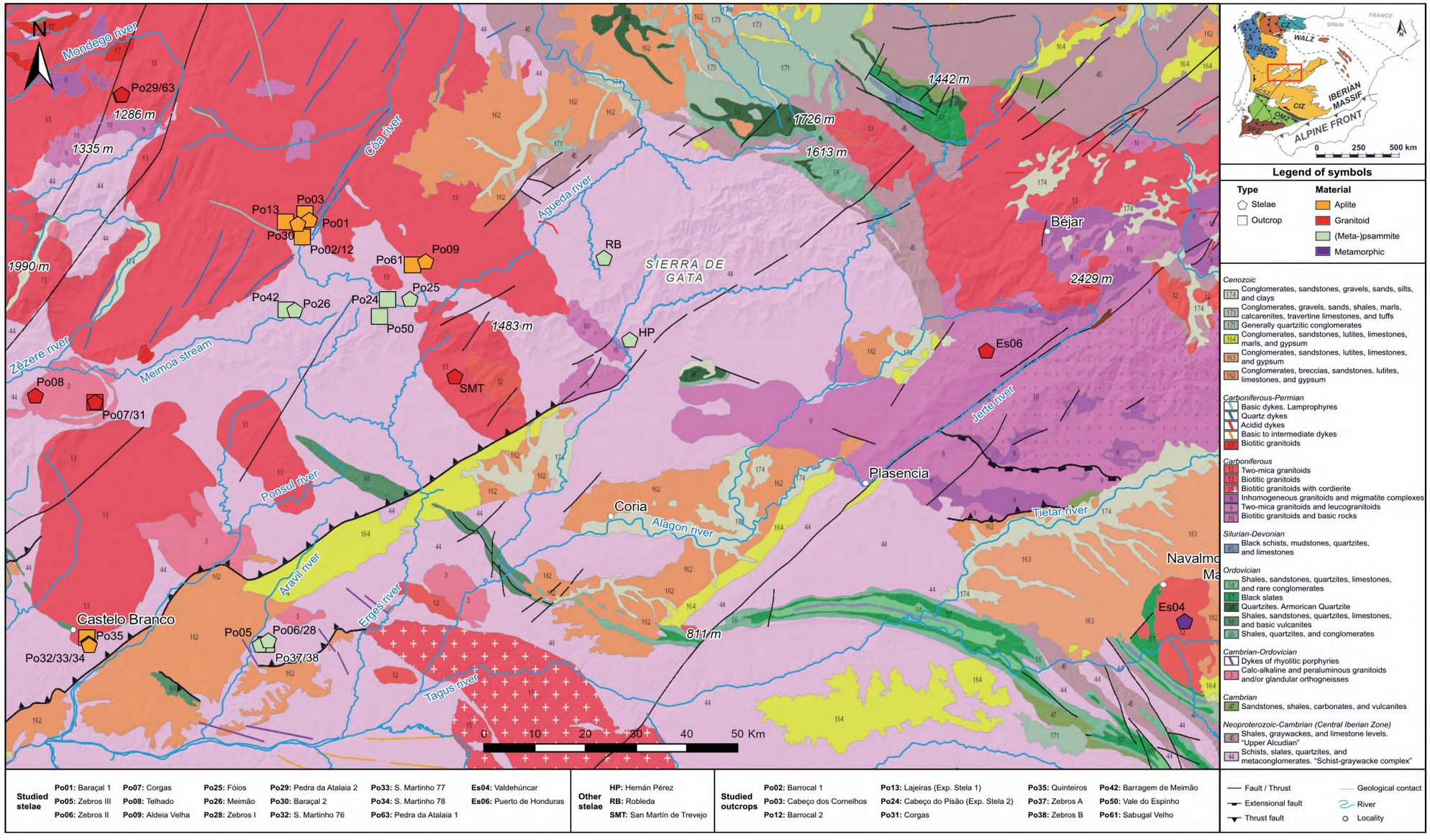

Figure 3. Simplified geological map (modified from IGME, 2015) showing the location of FBA-EIA stelae and analysed rock art monuments and outcrops between the Tagus river and the Iberian Central System, classified by lithological groups. Figure inset shows the subdivision of geological domains within the Iberian Massif (Julivert et al., 1977): CZ = Cantabrian Zone (greenish blue); WALZ = Western Asturias-Leonese Zone (light brown); GTMZ = Galicia-Tras-Os-Montes Zone (blue); CIZ = Central Iberian Zone (yellow); OMZ = Ossa Morena Zone (green); and SPZ = South Portuguese Zone (dark brown), as well as the Badajoz-Córdoba Shear Zone (BCSZ; grey belt).

the municipality of Sabugal (Celestino Pérez 2001, 48-50). Recent finds have shown that this area can be expanded, now including the Serra do Ralo and Serra da Gardunha to the west, and Sierra de Gredos to the east. Finally, a number of stelae have been found further south, towards the Tagus river. These stelae are exhibited and preserved today in the archaeological museums of Sabugal, Fundão, and Castelo Branco, as well as in communal spaces in the villages of Baraçal (Sabugal) and Rosmaninhal (Idanha-a-Nova).

4.1. Geological context

Between the towns of Celorico da Beira and Castelo Branco, 65 % of the area is covered by granitoid intrusions of pre-, syn- and post-orogenic Variscan age. Plutons (340 to 299 Ma) intruded in metamorphic and meta-sedimentary rocks that are older than the Late Carboniferous (Fig. 3; Sousa 1984; Castro *et al.* 1999). Further south, these plutons, which are partly batholiths like the Guarda granite massive of the Serra da Estrela, have also intruded the older Cambro-Ordovician granitoids (Ferreira, Alves and Macedo 1985). Most of these granitoid intrusions are monzogranites (Silva 2014) and between Celorico da Beira and Sabugal, 98% of the granitic rocks are biotite or two-mica granodiorite to monzogranite porphyry, or coarse to medium grained plutons with or without hornblende type amphiboles.

On the other hand, 35% of the southern study area are covered by Neoproterozoic to Carboniferous sediments and meta-sedimentary rocks intruded by several isolated granitoid plutons (Fig. 3). The Neoproterozoic Schist-Greywacke complex (Meireles *et al.* 2022) is subdivided into several formations. In the area of Sabugal, outcrops from the Gravato formation, and in Zebros, from the Malpica do Tejo formation, both from the Beiras group, have been used to carve rock art monuments. The Armorican Quartzite formation is also present as residual in the study area, with NW-SE oriented quartzite ridges dated to the Ordovician, particularly in the southern edges of the region, with defining prominent elevations due to differential erosion.

4.2. Petrographic characteristics

The comprehensive approach of the field study in the Beira provided the first petrographic data based on mesoscopic and microscopic analyses for 16 stelae and one statue-menhir, and nine monuments as well as 16 suspected outcrops were subject to geochemical studies. This allowed for a secure assignment to lithotypes for all Portuguese monuments, and of the secure or potential provenance of the raw material for ten examples. In total, eleven of the 17 rock art monuments correspond to magmatic rocks (granitoids and aplites), five to sedimentary rocks, and one to a metamorphic rock (see Tab. 1). Due to the restricted scope of this contribution, the focus will be on the Portuguese monuments and the conducted provenance studies and were replicated in the archaeological experimentation (see Araque Gonzalez *et al.*, this volume). The two examples from today Spanish territory, Puerto de Honduras (Es 06, granitoid) and Valdehúncar (Es 04), which is carved into a complex metamorphic rock that cannot be described here in detail, are only included here for completeness. They belong to the same geo-archaeological area that has not been separated by a national border in antiquity, however they will be presented elsewhere in a future study.

4.2.1. Granitoids

Altogether, ten rock art monuments from the Portuguese study area are made from granitoid rocks, eight of which correspond to syenogranites, for which no relation to a plutonic rock type could be established and hence they are likely to be aplites. This comprises the stelae from Aldeia Velha, Baraçal 1 & 2, Pedra da Atalaia 2, and São Martinho 76, 77 and 78. Their main mineral compositions range from 21-38 vol% quartz (Qz), 7-24 vol% plagioclase (Pl), 35-48 vol% orthoclase (Or), 4-15 vol% muscovite (Ms), and 0-15 vol% biotite (Bt) and thus indicating the light colour variations. They all show similar magmatic microstructures and grain sizes range from very fine to medium. The low biotite (black mica, averaging at 5 vol%) and high muscovite (white mica, averaging at 13 vol%) contents are characteristic and indicate that the rocks are of light coloured, or leucocratic, varieties. Two or three granitoid monuments (Corgas and Pedra da Atalaia 1; maybe Telhado) do not fall into this category. Beyond the abovementioned common properties, the mineralogical and microstructural patterns are highly specific for each rock and allowed for provenance studies. The monuments will be presented in the following paragraphs.

The stela of **Aldeia Velha** (Sabugal) (Po 09) (Vilaça, Osório and Santos 2011) was found ca. 2 km northeast of the proto-historic settlement of Sabugal Velho and displays some difficult to interpret motifs in addition to the basic composition (Fig. 2. A). It is carved into an isotropic, polygonal granular to interlobate, small to medium grained, and slightly hiatal granite rock with polycrystalline Qz accumulations forming patches; its crystalline structure is thus very similar to Baraçal 1 and 2. Bt is present as titanobiotite, where mostly idiomorphic titanite forms distinctively pleochroic rims in the Bt, with some sagenite microstructure, green and rich in rutile needles (Fig. 5c). Pleochroic halos could be observed around mineral inclusions of

Table 1. Results from petrographic analyses of stelae and outcrops in the Beira (Portugal) and northern Extremadura (Spain). It must be noted that in most cases, only those stelae where microscopic analyses were conducted could be classified. Exceptions to this are the stelae of Fóios (Po 25, characterized without a need for invasive sampling) and Pedra Atlaia 1 (Po 63, porphyric granitoid with large minerals, no sampling required). All other mesoscopic analyses remain preliminary and require confirmation (all analyses by R. Ferreiro Mählmann). Abbreviations: Exp. = experimental, Med. = medium, cl. = clast, meta. = metamorphic. Sample identification: Po = Portugal, Es = Spain.

					Main minerals			
Name	**No**	**Scope**	**Lithotype**	**Class**	**Qz** vol%	**Feld-spar** vol%	**Other minerals** vol%	**Comment**
Stelae from the Beira Interior (Portugal) and Northern Extremadura (Spain)								
Aldeia Velha	Po 09	Micro	Two-mica syenogranite (aplite)	Hard	38	48	10 Mica 3 Others	
Baraçal 1	Po 01	Micro	Two-mica syenogranite (aplite)	Med. to hard	35	43	19 Mica 3 Others	Outcrop Po 03
Baraçal 2	Po 30	Micro	Leucocratic muscovite-syenogranite (aplite)	Hard	28	59	15 Mica	Outcrop Po 12
Corgas	Po 07	Micro	Biotite- monzogranite (porphyry)	Hard	26	58	13 Mica 2 Others	Plutonic rock Outcrop Po 31
Fóios	Po 25	Meso	Meta-wacke to sub-arkose	Med.	no microscopic data			Outcrop Po 24
Meimão	Po 26	Meso	Quarzitic meta-psammite	Med.	no microscopic data			Outcrop Po 42
Pedra Atalaia 1	Po 63	Meso	Quartz diorite to granodiorite	Med. to hard	20	53	27 Mica	Coarse porphyry plutonic rock
Pedra Atalaia 2	Po 29	Micro	syenogranite	Hard	33	50	16 Mica	Probably an aplite
Puerto de Honduras	Es 06	Micro	Two-mica syenogranite	Hard	33	45	25 Mica 5 Others	
S. Martinho 76	Po 32	Micro	Monzo- to syenogranite	Hard	21	59	15 Mica 5 Others	Probably an aplite
S. Martinho 77	Po 33	Micro	syenogranite	Hard	23	54	20 Mica 3 Others	Probably an aplite
S. Martinho 78	Po 34	Micro	Syenogranite (aplite)	Hard	22	63	21 Mica	Probably outcrop Po 35
Telhado	Po 08	Micro	Monzo- to syenogranite	Hard	33	60	7 Mica	Plutonic rock
Valdehúncar	Es 04	Micro	Granulitic Monzogranite	Hard ?	39	26	10 Mica 5 Others	20 vol% complex blasthesis
Zebros I	Po 28	Micro	Arkose	Med.	32	62	6 Lithic cl.Matrix < 15%	Meta-arkose
Zebros II	Po 06	Micro	Arkose	Med.	32	68	0 Lithic cl.Matrix < 15%	Meta-arkose
Zebros III	Po 05	Micro	Arkose	Soft	29	65	6 Lithic cl.Matrix < 15%	Meta-arkose

Outcrops in the Beira Interior and Beira Baixa (Portugal)								
Barragem de Meimão	Po 42	Micro	Quarzitic meta-psammite	Med.	83	15	2 Lithic cl.	Meimão, same rock, the coarsest strata
Barrocal 1	Po 02	Micro	Leucocratic muscovite-syenogranite (micro- plutonic rock)	Hard	32	43	22 Mica	Similar to Baraçal 2, same lithotype
Barrocal 2	Po 12	Micro	Leucocratic muscovite-syenogranite (aplite)	Hard	32	58	10 Mica	Baraçal 2, same rock
Corgas	Po 31	Micro	Biotite-monzogranite (porphyry)	Hard	27	56	13 Mica 4 Others	Corgas, same rock
Cabeço do Cornelhos	Po 03	Micro	Two-mica syenogranite (aplite)	Hard	33	44	19 Mica 4 Others	Baraçal 1, same rock
Cabeço do Pisão Exp. Stela 2	Po 24	Micro	Meta-wacke to sub-arkose	Med.	48	21	31 Micas	Fóios, same rock, but higher meta. grade
Lajeiras Exp. Stela 1	Po 13	Micro	Syenogranite (aplite)	Hard	34	52	14 Mica	Baraçal 2, same rock
Quinteiros	Po 35	Micro	Syenogranite (aplite)	Hard	23	57	16 Mica 4 Others	S. Martinho 78, same lithotype, (aplite)
Sabugal Velho	Po 61	Micro	Two-mica syenogranite (aplite)	Hard	35	52	11 Mica	Aldeia Velha, same lithotype
Vale de Espinho	Po 50	Micro	Lithic wacke	Med.	73	13	14 Lithic cl. Matrix > 15 %	Fóios, similar rock, same meta. grade
Zebros A	Po 37	Micro	Meta-arkose	Med.	34	59	7 Lithic cl. Matrix < 15%	Zebros I Same rock
Zebros B	Po 38	Micro	Meta-sub-arkose to wacke	Med.	76	24	0 lithic cl.Matrix > 15 %	Zebros II & III

apatite, zircon, monazite, and xenotime (see below, Baraçal 1, Fig. 5d), but as a singularity also around titanite and rutile. Magnetite is present and mesoscopically visible. The rock has unique characteristics, namely a radioactivity measured at 32 mSv and is magnetic, with the Nd-magnet (small geologist magnet) adhering to the rock. It is determined as a magnetite, titanite bearing **two-mica syenogranite (aplite).**

The stela of **Baraçal 1** (Sabugal) (Po 01) (Curado 1984; Santos, Vilaça and Marques 2011) is the only stelae in Iberia that is carved with a high relief and shows a basic sword-shield –spear motif composition (Fig. 2 C). It is made from an isotropic, unoriented hypidiomorphic, polygonal granular to interlobate, small to medium grained, and slightly hiatal granite rock with a specific Qz hexagonal idiomorphic cut (Fig. 4a) of very fine grain size in polycrystalline Qz accumulations (with some fluid inclusion rich Qz forming segregations approaching cm-scale). The slightly sericitized, coarser Pl grains with polysynthetic twinning tend to be hiatal, which is accentuated by medium grained short prismatic tabular Or tending to be idiomorphic and unaltered. The contact to Qz, Or and Pl is interlobate to polygonal, accessory mineral inclusions contain apatite, rutile, zircon, and spurs of monazite, all causing pleochroic halos in Bt, and magnetite (Fig. 4 & 5a, b, d). Alteration bands in the thin section with very fine-grained re-crystallizations and highly sericitized Pl and Or (Fig. 4 a) correspond with light grey to white mesoscopic bands in the stela and are interpret as hydrothermal altered pathways.

As it is the case with all other aplites of the study area,

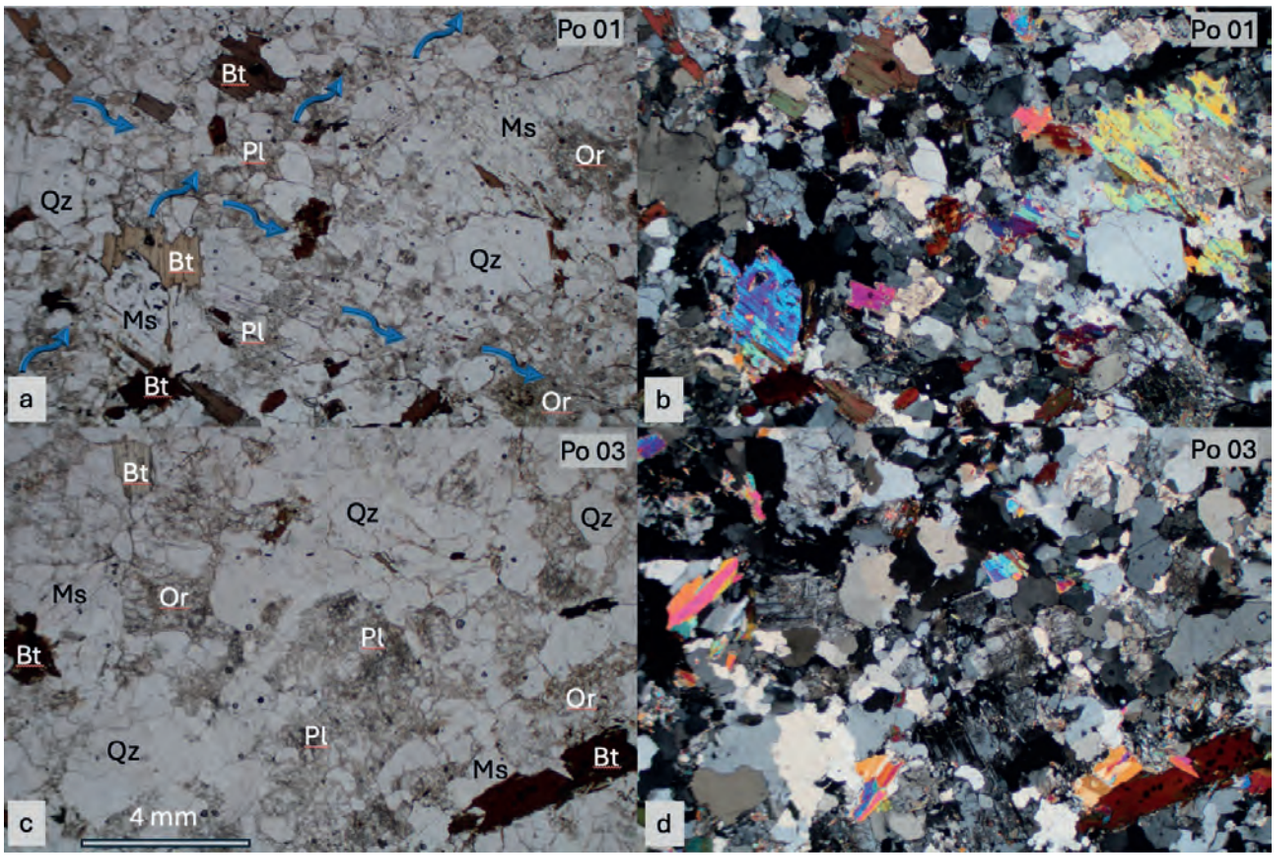

Figure 4. Baraçal 1 (Po 01) and Cabeço do Cornelho aplite (Po 03): Microphotographs with plane polarized (a and c) and crossed polarized light (b and d) (magnification: 16 x). In a. and c. feldspar (Pl = plagioclase, Or = orthoclase) can be easily recognized by the sericitized rough surface and distinguished from the colorless quartz (Qz) and muscovite (Ms). Biotite (Bt) shows an intensive pleochroism from light brown to dark red/isotropic (black). The blue wavy arrows indicate the direction of fluid alteration affecting mostly the feldspars, but also Bt (center of figure a, green alteration). (Microphotographs. R. Ferreiro Mählmann).

Or can be better distinguished from Pl and contrast the first results from mesoscopy. The microscopic study revealed a compositional increase of Or versus Pl and as a consequence, in the Streckeisen diagram the lithotype composition was shifted towards a rutile bearing **two-mica syenogranite (aplite).**

The stela of **Baraçal 2** (Sabugal) (Po 30) (Santos, Vilaça and Marques 2011) is made from a leucocratic rock similar to Baraçal 1, but without Bt and Ms reflecting with a high silver glance. This syenogranite is very fine to rarely medium grained, partly equi-granular, the Qz content is uniform granular, serial unoriented, hypidiomorphic, and the feldspar tend to be idiomorphic or partly slightly hiatal. The dominant felsic minerals form discrete patterns with micro-polycrystalline Qz patches (< 2.0 mm) and crystal pressure twining is frequently developed. The light beige Or (mesoscopic) shows perthitic exsolutions (mostly patch- to flame-like) and some microcline twinning under the microscope, and some grains have a Carlsbad twinning. Two generations of felsic minerals can be found, with inclusions of rutile needles, zircon, and spurs of apatite. The Ms content is inhomogeneous, frayed xenomorphic to subidiomorphic, dispersed very fine grained, pseudo-hexagonal shaped, short-prismatic flaky and relatively rich in Fe, as indicated by a characteristic pale green colour. The rock is thus determined as a **leucocratic muscovite-syenogranite (aplite).**

The statue-menhir of **Corgas** (Fundão) (Po 07) (Banha, Veiga and Ferro 2009) features a "bi-anchoriform" motif (undefined) and a sword, both engraved in high relief, akin to the Alentejo-type stelae dating back to the MBA. It is made from a medium-grained, unoriented, hetero-granular granitoid with porphyritic structure. It is characterized by anisotropic patch-like mineral accumulations, contributing to increased anisotropy. The grain structure, consisting primarily of feldspar xenocrysts, is slightly hiatal. Qz is fine-grained, often forming polycrystalline patches, mostly intragranular to interstitial, isometric xenomorphic, and interlobate. It can be found as an inclusion in feldspars, mainly Or. Pl is xenomorphic to long prismatic subidiomorphic, occasionally exhibiting idiomorphic characteristics, and is mostly well zoned. Pl cores are often heavily altered, with some showing signs of sericitization and sassuritization. A complex evolution in the magmatic chamber can be noted from the Pl zoning patterns. Or is predominantly short prismatic, often displaying complex inclusion

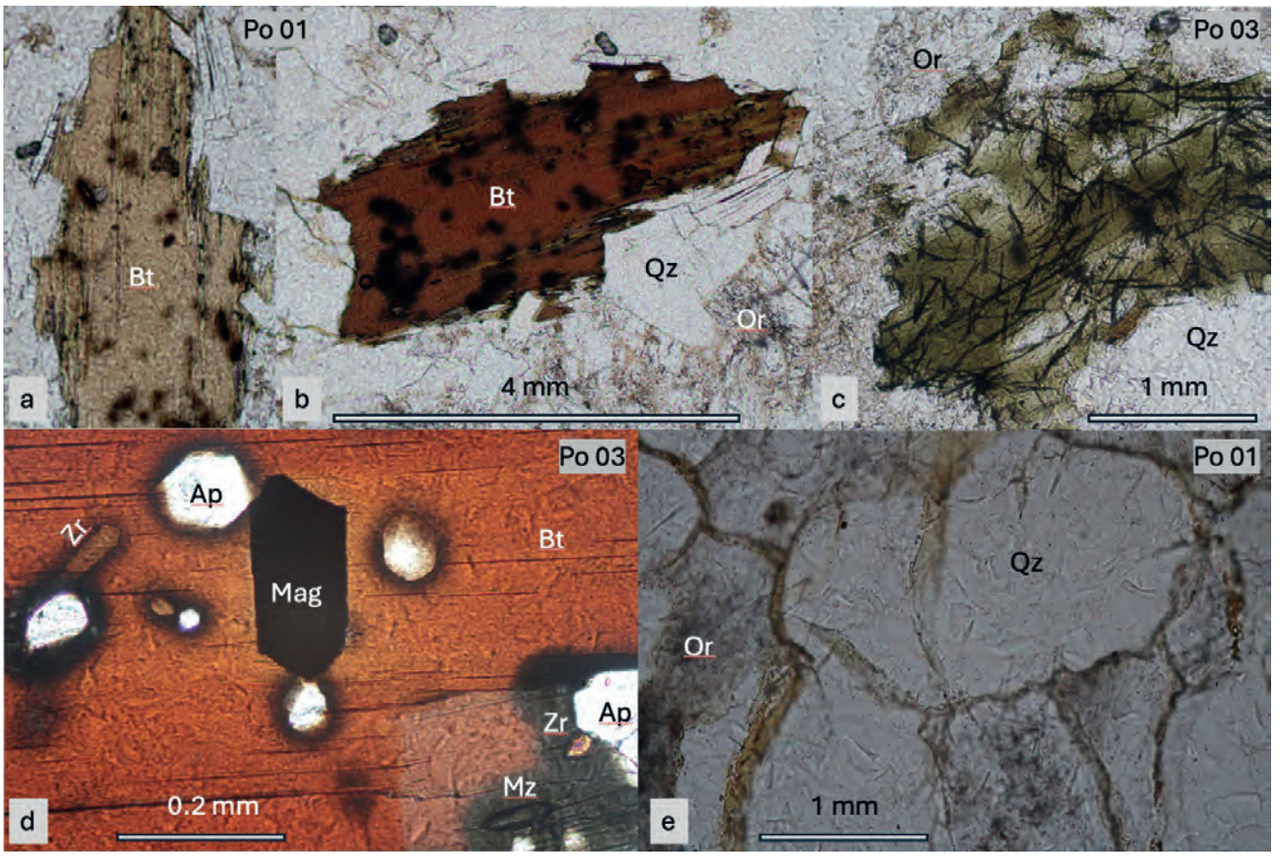

Figure 5. Baraçal 1 (Po 01) and Cabeço do Cornelho aplite (Po 03): Microphotographs with plane polarized light. Figure a. and b. have the same size (50 x) and show biotite (Bt) with an intensive pleochroism from light brown to dark red/isotropic (black). In figure c. a green altered biotite (see Figure 4a. at the center) is transformed to chlorite with a rutile needle sagenite microstructure (100 x). In d. all inclusions, except magnetite (Mag) cause pleochroic halos (Ap = apatite, Mz = monazite, Zr = zircon, 2000 x). In e. limonite in grain contacts around quartz (Qz) and orthoclase (Or) fills the space in the fissures lowering the cohesion (100 x). If Po 01 is indicated the same can be observed in Po 03 and vice versa. (Microphotographs. R. Ferreiro Mählmann).

series with Pl of a different generation, Bt, and Qz. As with Pl, Or cores are frequently sericitized and well-zoned and myrmekite frequent. Ms is highly dispersed and present in spurs, with some flakes crystalized in altered Or. Bt is typically dark brown to light brown-yellow, exhibiting strong pleochroism. Accessory minerals include titanite, magnetite, cordierite, and hornblende, as well as some chlorite, epidote, apatite and zircon. As such, this rock is a hornblende-bearing **biotite-monzogranite**.

The stela of **Pedra da Atalaia 1** (Celorico da Beira) (Po 63) (Vilaça, Santos and Gomes 2011) was found north of the core area of the stelae. The rock was only approached mesoscopically due to its porphyry nature, with very big feldspars, composed of small to medium grained Qz, very coarse grained long prismatic white Pl, light beige to diffuse pale brown-yellow-coloured coarse-grained xenocrysts of Or. Bt is coarser grained than Ms and both are well preserved with a high metallic glance. Accessory minerals are highly disseminated and dispersed Ms and Hlb. This plutonic rock is very similar to the Guarda batholith, however it tends towards a monzogranite (Silva, 2014), and the stelae rock is a porphyry **quartz diorite to granodiorite**. It is noteworthy that this is the coarsest grained stela that has been studied within this project and the only porphyry granitoid that has been used for rock art (see chapter 12). Contrary to other analysed stelae from this area, it is not an aplite or syenogranite.

Pedra da Atalaia 2 (Celorico da Beira) (Po 29) (Vilaça, Santos and Gomes 2011) is the fragment of a rock art monument that was found together with the stela of Pedra da Atalaia 1. It is carved into a medium grained rock with a very specific granular micro-structure of a polygonal-granular matrix that is typical for an aplite (glomerophyric accumulations of Or + Pl + Ms and Bt). Accessory minerals are rutile, titanite, and chlorite (an alteration product of Bt). The rock is a **syenogranite** and can be interpreted as an aplite due to its characteristics.

The three rock art monuments of **São Martinho** (Castelo Branco) (Vilaça, Santos and Marques 2004) are atypical among the LBA western Iberian stelae. **São Martinho Nr. 76** and 77 are fragmented statue-menhirs, with 76 depicting anthropomorphic figures with shields and horned helmets. **São Martinho Nr. 78** is possibly a repurposed menhir, engraved with an anthropomorphic

figure, which is involved in a deer hunting scene, alongside other elements also present in FBA stelae (sword, mirror, and fibula).

São Martinho Nr. 76 (Po 32) is made from a slightly porphyry, fine to medium grained granitoid with a trend to a coarse grain size. The rock is heterogranular with a serial matrix and hiatal xenocrysts. The Qz content is particularly low in this granitoid, with two generations of Qz detected. Mesoscopically, the Or is more intensive coloured than in other samples (beige to light chestnut brown with reddish to pinkish outer zones). Pl and Or form complex accumulations with inclusions of accessory minerals of which Ms is disperse, mostly fine grained, fine grained Bt with chlorite, alongside apatite, spurs of titanite, idiomorphic magnetite, and rutile needles. The rock is a **monzo- to syenogranite** with an outstandingly high cordierite content of 5 vol%.

The petrology of **São Martinho Nr. 77** (Po 33) is very similar to São Martinho Nr. 76, but finer grained and serial to partly equigranular. Spurs of granular titanite, altered magnetite (limonite), chlorite in Bt, and rutile needles were observed. The Ms and Bt crystal and grain intergrowth microstructures are identical to São Martinho Nr. 76, meaning this is the same lithotype. However, there is a compositional shift that differentiates this rock as a **syenogranite**.

São Martinho Nr. 78 (Po 34) is a slightly hiatal (porphyry), fine to medium grained granitoid. The rock is inequigranular and serial, hypidiomorphic, and felsic larger xenocrysts (Pl, Or) tend to be idiomorphic. Pl is mostly short prismatic to long prismatic and shows inclusions and intergrows of Bt and Ms. Secondary minerals are disseminated disperse small-grained Ms and coarser grained Bt, partly a titano-biotite with strong pleochroic halos, alongside zircon, yellow monazite, xenotime, and difficult to determine cordierite. This rock is a **syenogranite** (**aplite**) and the presence of fibroblastic sillimanite (fibrolite) is an outstanding characteristic.

The stela of **Telhado** (Fundão) (Po 08) (Vilaça 2021) is possibly a transformed menhir that was decorated with a typical basic stelae design and additionally a helmet and mirror (Fig. 2 B). The medium to coarse-grained serial and isotropic rock has a schlieren-like inhomogeneity and Qz polycrystalline segregations up to a diameter of 3.7 mm form one pattern. Microscopic analysis corroborated an inhomogeneous mineral composition that had already been visible during mesoscopy (magmatic schlieren). The Qz segregations change to areas with feldspar accumulations. It contains long prismatic, light grey to grey, pale bluish Pl, tabular Or up to > 2 mm, with medium to coarse grained Bt reaching 1.2 mm, dispersed and partly forming polycrystalline accumulations. Anisotropy is caused by felsic mineral accumulations and nodes of Bt. The Or shows complex crystal grows and inclusion pattern with Pl and Qz. Ms is very fine grained and in highly dispersed spurs. Accessory minerals are chlorite, titanite, few opaque minerals, zircon, apatite, and rutile needles. The stela is made from a **monzo- to syenogranite**.

4.2.2. Sedimentary rocks

The stela of **Fóios** (Sabugal) (Po 26) (Curado 1986) is a plate of sedimentary rock from the Gravato formation that has lithified hard ground, which has been used for engraving. This rock was not sampled due to the risk of delamination and could be determined with mesoscopy. It consists of five stratified beds of silt to fine sand and the coarsest layer is medium sand, originating from clay bonded, graded fine sand to silt to silty clay stone. Each layer is limited at the bottom by an erosional horizon with a reddish colour, with some crossbedding, cut by the next erosional hiatus. The clay was recrystallized to very fine-grained sheet silicates (chlorite and Ms); Qz, feldspar and heavy minerals are well rounded, well sorted, and fractionated. The fine-grained white mica (or detrital sericite) and some prismatic feldspars are preferentially well-ordered parallel to bedding. There is a high degree of sedimentary facies maturities. Diagenetic lithification, compaction with solution sutures and bedding parallel load cast microstructure (denser layers sinking into underlying, less dense ones) are well preserved. The constituting layers of this rock are determined as **wacke to quartz arenite**, and the coarsest layer is probably a **sub-arkoses**.

The stela of **Meimão** (Penamacor) (Po 25) (Rodrigues 1958) displays a basic motif composition with additional objects (Fig. 2 D) and is partly fractured and damaged. The rock could not be sampled for microscopy but appears to be a psammite (probably from the Gravato formation). Mesoscopically, the rock showed a medium grained serial quarzitic micro-structure, crossbedding, low developed concave lamination, and two planar erosional disconformities in three beds. At the top of the bedding planes granulation starts with a coarser grain fraction (fine sand), followed by homogeneous grained layers, mostly silt grained, of dense, massive compaction; the low-developed stratification is strongly re-crystallized. An early stage of slaty cleavage characterizes a shale rock from the sub-greenschist facies (Ferreiro Mählmann *et al.*, 2024, fig. 9). This bedded rock could be determined as **quarzitic meta-psammite**, probably a quarzitic meta-arenite or a meta-wacke.

The stelae of **Zebros I** (Po 28) (Cardoso 2011), **Zebros II** (Po 06) (Henriques, Chambino and Caninas 2012) and **Zebros III** (Idanha-a-Nova) (Po 05) could be determined as **arkoses** and **meta-arkose**, which are re-definitions if compared to their formerly assessed lithology and this will

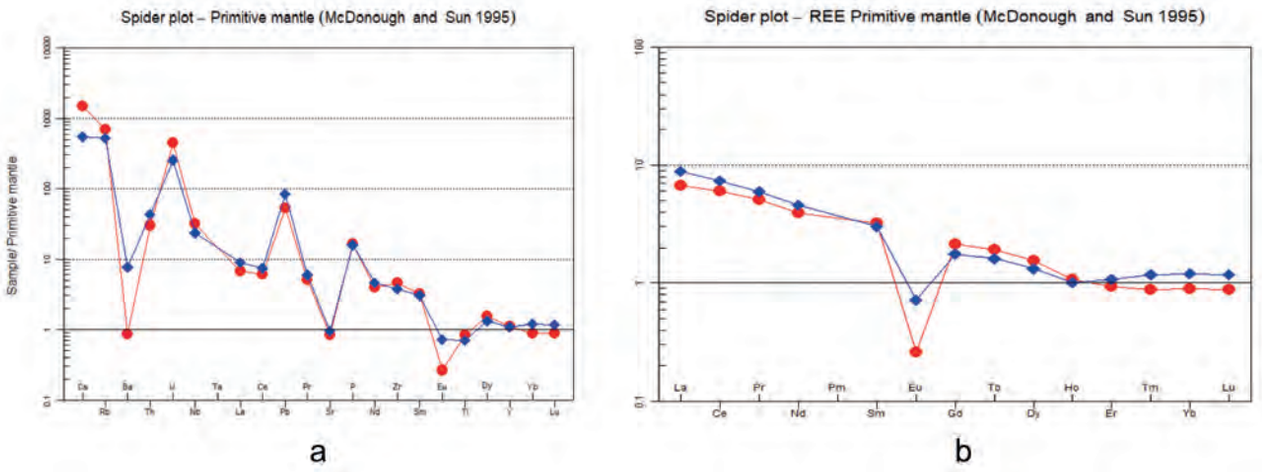
Spider plot – Primitive mantle (McDonough and Sun 1995)
Sample/ Primitive mantle
Spider plot – REE Primitive mantle (McDonough and Sun 1995)
a
b

Figure 6. Comparison of a) the element concentration pattern and b) the REE pattern of samples Po 01 (Baraçal 1, red) and Po 03 (Cabeço do Cornelhos, blue). Values of the element concentration pattern are normalized to average concentrations of the upper continental crust (Taylor and McLennan 1995). REE values are normalized to an average composition of the primitive mantle (McDonough and Sun 1995).

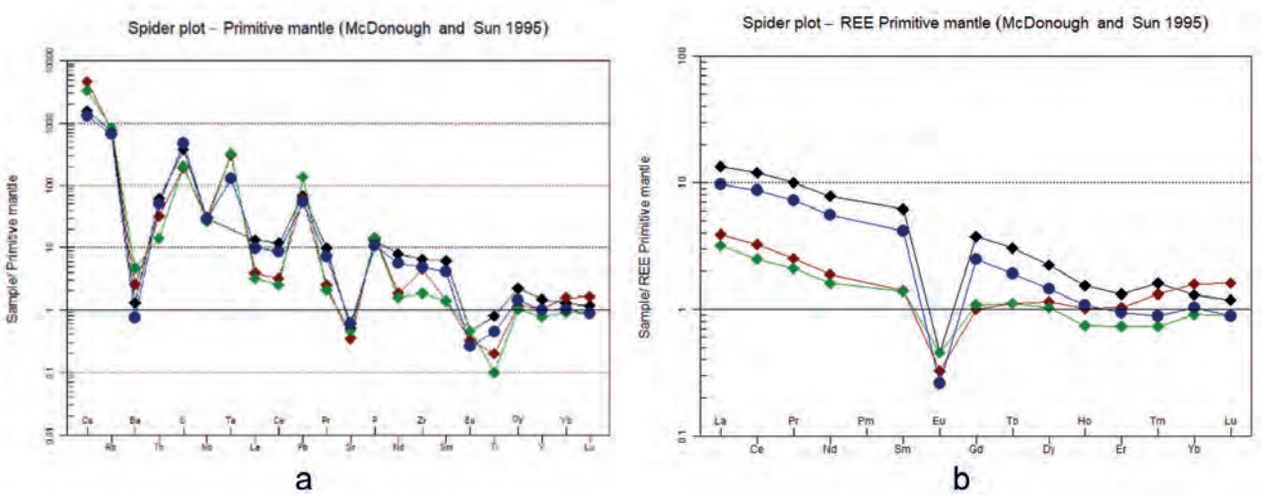
Spider plot – Primitive mantle (McDonough and Sun 1995)
Sample/ Primitive mantle
Spider plot – REE Primitive mantle (McDonough and Sun 1995)
Sample/ REE Primitive mantle
a
b

Figure 7. Comparison of a) the element concentration pattern and b) the REE pattern of samples Po 30 (Baraçal 2, dark blue) and Po 12 (Barrocal 2, black). Identical in the element distribution pattern are samples Po 13 (dark red) and Po 16 (dark green), both from the Lajeiras aplite. Values of the element concentration pattern are normalized to average concentrations of the upper continental crust (Taylor and McLennan 1995). REE values are normalized to an average composition of the primitive mantle (McDonough and Sun 1995).

be published in a forthcoming study. The Malpica do Tejo formation is mainly composed of meta-wackes, meta-clay stones and some meta-arenites. In this context, arkoses are very low-level component rocks. Meta-arkoses with the same metamorphic grade as found in the stelae are restricted to outcrops 400m south/southeast of the find spots in a very circumscribed area with coarse grained dykes (partly pegmatitic) and with a grade of contact metamorphism equal to the stelae rocks.

4.3. Geochemical characteristics and provenance studies

This paragraph will discuss the eventual provenance that could be established with geochemical methods for ten of the abovementioned rock art monuments with the examples of the stelae Baraçal 1 and 2 and suspected outcrops (see Table 2). The geochemical results for other stelae (Aldeia Velha, Corgas, São Martinho Nr. 78, Fóios, Meimão, Zebros I, II and III) will be published elsewhere due to the scope of this chapter.

Cabeço dos Cornelhos (Po 03) is the corresponding outcrop of **Baraçal 1 (Po 01)** and is a granitoid elevation located between the villages of Baraçal, Vila do Touro and Rapoula do Côa, ca. 1 km northwest of the findspot of the stela. At the summit, an E-W oriented, leucocratic aplite intruded the Pega batholite, which is composed of a porphyry coarse grained two-mica monzogranite. The provenance of the stela from this aplite dyke is evidenced by the overlap in the spider diagram and REE diagram (Fig. 6).

The stela of **Baraçal 2 (Po 30)** can be attributed to the outcrop at Barrocal (**Barrocal 2, Po 12**), which had been

Table 2. Major (wt.%) and trace (ppm) element compositions of the samples Po 01, Po 03, Po, 30, Po 13, and Po 16, stela* = sample from the slab used as experimental stela. (bdl = blow detection limit, n.d. = not defined)

Sample		Po 01 Baraçal 1stela	Po 03 Cabeço do Cornelio	Po 30 Baraçal 2 stela	Po 12 Barrocal 2	Po 13 Lajeiras stela*	Po 16 Lajeiras 4
SiO_2	wt %	72.52	72.02	73.47	72.32	74.12	74.52
TiO_2	wt %	0.17	0.14	0.09	0.16	0.04	0.02
Al_2O_3	wt %	14.39	14.25	16.09	15.83	14.88	14.48
Fe_2O_3	wt %	1.36	1.39	0.59	0.84	0.74	0.45
MnO	wt %	0.02	0.02	0.01	0.01	0.07	0.06
MgO	wt %	0.25	0.17	0.19	0.14	0.07	0.05
CaO	wt %	0.53	0.55	0.05	0.09	0.40	0.29
Na_2O	wt %	3.35	4.95	3.06	3.38	4.43	4.02
K_2O	wt %	5.32	5.00	3.74	4.69	3.40	3.97
P_2O_5	wt %	0.34	0.33	0.22	0.27	0.30	0.29
LOI	wt %	1.63	1.07	2.40	2.15	1.40	1.60
S	ppm	122.80	bdl	n.d.	71.70	n.d.	n.d.
Cl	ppm	bdl	475.00	n.d.	bdl	n.d.	n.d.
Sc	ppm	8.80	6.80	7.65	7.40	3.45	2.68
V	ppm	2.03	3.94	2.01	4.13	0.51	0.17
Cr	ppm	0.27	1.06	<0.04	1.46	<0.04	1.18
Co	ppm	0.22	0.54	0.58	0.38	101.37	144.12
Ni	ppm	bdl	0.49	0.46	0.05	0.99	1.13
Cu	ppm	15.55	5.99	24.52	7.58	1.72	0.23
Zn	ppm	15.53	39.50	22.14	21.15	52.65	35.53
Ga	ppm	n.d.	n.d.	30.98	n.d.	26.15	23.54
Rb	ppm	414,01	314,29	392.47	447.49	453.02	507.85
Sr	ppm	16.52	18.91	12.19	10.11	6.99	9.20
Y	ppm	4.80	4.70	4.21	6.30	4.52	3.31
Zr	ppm	47.71	39.36	50.58	69.23	47.42	19.66
Nb	ppm	20.63	15.49	19.08	19.22	19.99	17.59
Cd	ppm	n.d.	n.d.	<0.0005	n.d.	<0.0005	<0.0005
Sn	ppm	39.00	13.10	37.56	33.11	69.36	55.59
Sb	ppm	0.65	0.44	0.09	0.10	0.35	0.25
Cs	ppm	31.45	11.39	27.68	32.88	97.70	69.50
Ba	ppm	5.65	50.59	4.91	8.63	17.24	30.60
Hf	ppm	n.d.	n.d.	2.59	n.d.	2.07	1.08
Ta	ppm	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Pb	ppm	7.94	12.65	8.04	10.44	9.29	20.58
Th	ppm	2.40	3.42	4.01	4.95	2.58	1.13
U	ppm	9.03	5.12	9.26	7.60	3.84	4.02
La	ppm	4.37	5.78	6.29	8.73	2.54	2.07
Ce	ppm	10.16	12.40	14.54	20.07	5.44	4.19
Pr	ppm	1.29	1.52	1.83	2.53	0.64	0.53
Nd	ppm	4.93	5.74	6.93	9.82	2.34	2.00
Sm	ppm	1.31	1.22	1.69	2.50	0.57	0.56
Eu	ppm	0.04	0.11	0.04	0.07	0.05	0.07
Gd	ppm	1.17	0.96	1.36	2.04	0.54	0.59
Tb	ppm	0.19	0.16	0.19	0.30	0.11	0.11
Dy	ppm	1.04	0.89	0.97	1.50	0.77	0.69
Ho	ppm	0.16	0.15	0.16	0.23	0.15	0.11
Er	ppm	0.41	0.47	0.41	0.58	0.45	0.32
Tm	ppm	0.06	0.08	0.06	0.11	0.09	0.05

used as a quarry (now abandoned) to obtain the leucocratic aplite, located between the villages of Quintas de São Bartolomeu and Quinta das Vinhas. Here, a micro-plutonic rock of an apophysisan intrusion that is thicker than a dyke, however smaller than a pluton (>100 m^2 and <1000 m^2) is accessible. This apophysis relates to dykes extending in E-W direction into the Pega batholite intruding also the apophysis (Barrocal 1, Po 02). In this area, the modal composition of the granitoids shows a high variability. In the Barrocal quarry, the micro-plutonic rock Barrocal 1 is a leucocratic muscovite-syenogranite and microscopically very similar to Baraçal 2. The leucocratic muscovite-syenogranite aplite (Barrocal 2) however is in its main mineral, secondary and accessory mineral composition, heavy mineral assemblage, and microstructure the same rock (Tab. 1). The geochemical results, including the plots in the spider and REE diagrams (Fig. 7) evidence the provenance of the stela Baraçal 2 from the aplite found in the apophysis at the Barrocal quarry. There is a remarkable comparability of the geochemical composition of the Aldeia Velha stela (Po 09) with Barrocal 1 (Po 02). This demonstrates that the aplite-apophysis magmatic system is closely interrelated.

Due to its total exploitation over centuries, the quarry of Barrocal did not provide any suitable rocks for the replication experiment (see Araque Gonzalez *et al.*, this volume). As a consequence, a nearby aplite connected with the apophysis of Barrocal was prospected at the abandoned quarry of Lajeiras (Po 13) and showed the same main and secondary minerals composition as well as identical microstructural characteristics. The only difference is the amount of apatite, rutile, zircon, and monazite (all together <1 vol%). In summary, the Lajeiras aplite is the same rock that has been determined for the stela Baraçal 2 and the aplite in the outcrop Barrocal, and thus the slab used for the experimental stela (Po 13) represents the physical characteristic and same rock quality.

5. The stelae from the Zújar valley and southern Extremadura

The Zújar valley, situated in the eastern part of the province of Badajoz, has the highest density of stelae discoveries in the Iberian Peninsula (Celestino Pérez and Paniego 2021). The area is traversed by the Guadiana, Zújar, and Guadalmez rivers, as well as several seasonal subsidiary streams that flow in various directions throughout the region. The region has favourable characteristics for grazing and cultivation. It has been a place of occupation and transit since prehistoric times, as indicated by the high presence of rock shelters and cave paintings (Martínez Perelló 1999).

The majority of the stelae findings were found in the vicinity of the La Serena reservoir and the rivers that drain it (Zújar, Guadálmez, Valdeazogues and Alcudia). These findings were located between the towns of Cabeza del Buey, Capilla and Almadén and, a slightly further south, in the towns of El Viso and Belalcázar. However, some stelae findings have also been discovered near the towns of Valverde de Mérida and Don Benito, as well as in the vicinity of Herrera del Duque and to the south of Horcajo de los Montes, all close to the Guadiana river (Fig. 8).

Most of the stelae are currently held in the Provincial Archaeological Museum of Badajoz and the Provincial Archaeological Museum of Ciudad Real, although there are also examples in the "Posada del Mor" House-Museum in Torrecampo (Córdoba), the Francisco Pablo Holgado Historical-Mining Museum (Almadén) and at archaeological sites or in private houses in the region. The images on stelae in this area are known for their complexity, prominently featuring the human figure and various objects such as chariots, mirrors, bows, and arrows (Fig. 9; see also Paniego, this volume).

5.1. Geological context of the Zújar valley

The Zújar valley stelae are situated in the central-southern region of the Iberian Massif, specifically in the south-eastern part of the Central Iberian Zone (CIZ), close to the boundary with the Ossa Morena Zone (OMZ; see inset in Fig. 8; Julivert *et al.* 1977). In the extreme southwest of the study area, the Neoproterozoic to Cambrian materials exposed in the OMZ consist of gneissic, amphibolitic, migmatitic, and eclogitic thrusting sheets that overlie the Upper Proterozoic metasedimentary sequences (Ábalos and Eguíluz 1991). These units were intruded by several magmatic pulses of (ultra-)basic to acidic affinity during Cadomian times. Discordant with these lithologies are several low-grade metasedimentary series of Lower to Middle Palaeozoic age, similar to those found in the CIZ. All these units were structured during the Variscan Orogeny in deformation bands that predominantly ran in a WNW-ESE direction.

The CIZ is structured following large vertical folds, with Palaeozoic synclines providing the highest reliefs, and large depressed extensions in which Pre-Ordovician detrital materials outcrop in the anticlinal cores (IGME 1987a). The Neoproterozoic to Cambrian basement is widely represented by an alternation of psammitic and pelitic levels showing high diagenetic degree to low-grade metamorphism, belonging to the so-called Schist-Greywacke Complex (SGC), together with scarce detrital and carbonate levels of the Upper Alcudian.

The terrain in these areas is gently undulating, with elevations ranging from approximately 400 to 575 meters. The Palaeozoic materials create a mountainous landscape,

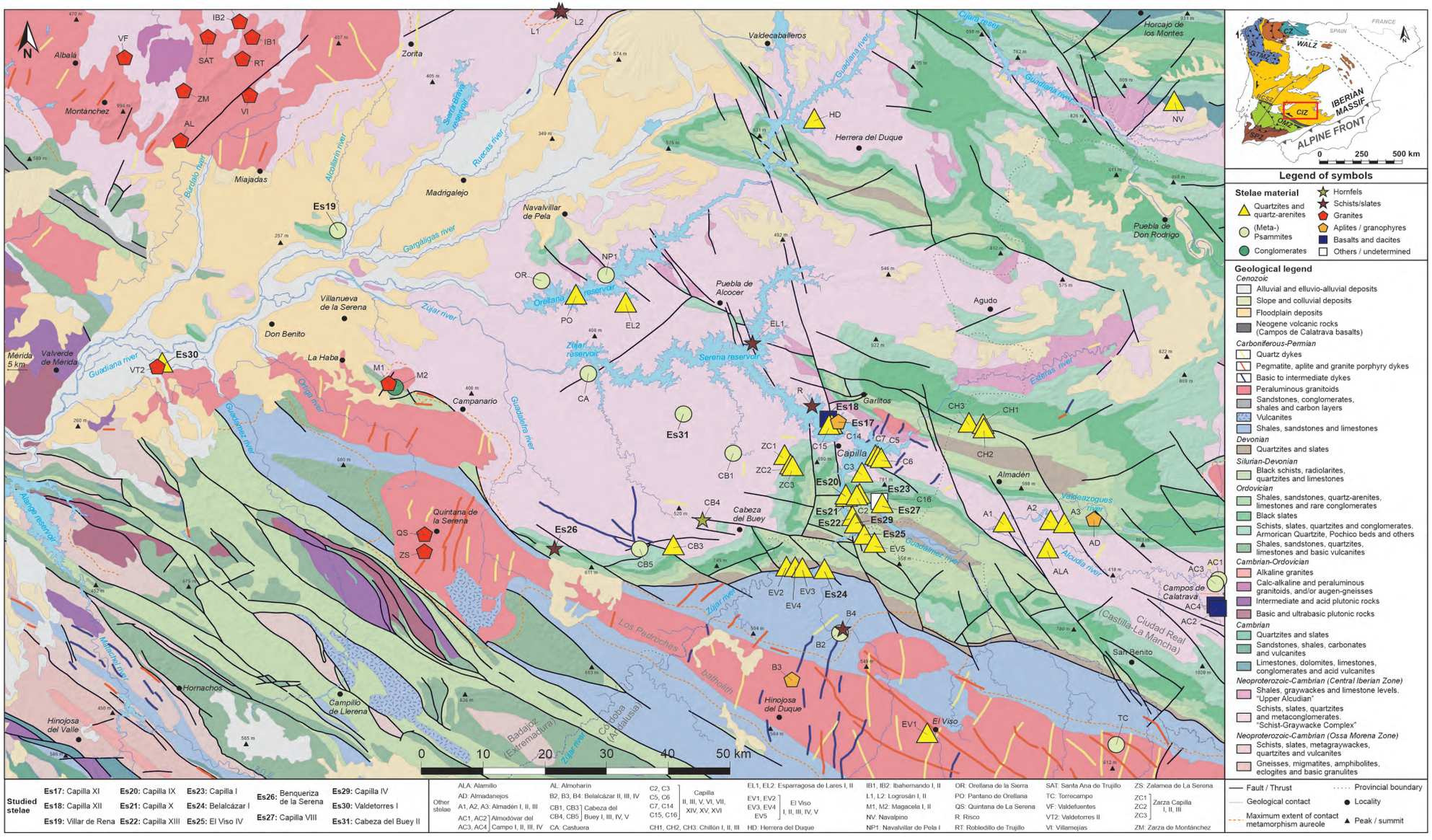

Figure 8. Simplified geological map (modified from IGME, 2015) showing the location of warrior stelae of the Zújar valley and surrounding areas, classified by lithological groups. Figure inset shows the subdivision of geological domains within the Iberian Massif (Julivert et al. 1977): CZ = Cantabrian Zone (greenish blue); WALZ = Western Asturias-Leonese Zone (light brown); GTMZ = Galicia-Tras-Os-Montes Zone (blue); CIZ = Central Iberian Zone (yellow); OMZ = Ossa Morena Zone (green); and SPZ = South Portuguese Zone (dark brown). It is also illustrated the high-deformation zone separating the CIZ and the OMZ, the Badajoz-Córdoba Shear Zone (BCSZ; grey belt).

Figure 9. Stelae from the Guadiana valley. A. Magacela (height: 143 cm) B. Valdetorres I (Es 30, height: 101 cm) C. Benquerencia de la Serena (Es 26, height: 77 cm) D. Belálcazar I, El Mato (Es24, height: 100 cm) (unscaled; Photographs: A. Felicísimo, KRAKEN Group).

with peaks reaching up to 938 meters. These heights correspond to the continuous and robust quartzite strata of the Lower Ordovician, referred to as "Armorican Quartzite", which are typically arranged sub-vertically. The depressed areas are composed of Middle Ordovician (including the "Pochico beds") to Lower Carboniferous pelitic packages, interlayered with sandstones, quartz-arenites or conglomerates, with scarce carbonate levels (IGME 2005a, b).

Several Variscan plutonic units intruded the Proterozoic to Palaeozoic basement in the study area, forming the La Haba and Mérida massifs, in structural continuity with the large Los Pedroches batholith; and the Zorita and Montánchez-Albalá plutons, to the NW of the region. In general, they consist of granitoid rocks, varying from granodiorite to syenogranite, with rare leucogranite and aplite intrusions, in which varieties with biotite, biotite and amphibole, biotite and muscovite, and biotite and cordierite can be distinguished.

Carboniferous to Permian dyke swarms of acidic (pegmatites, aplites, granite porphyries and rhyolites) and basic to intermediate (dolerites, microdiorites, and dacites) affinities crosscut all the materials in NNE-SSW to NW-SE directions. Overlying all these materials are sedimentary deposits and volcanic to volcano-sedimentary units, including acidic tuffs and cinerites, as well as sparse basalts, attributed to the Carboniferous. The region also contains several generations of quartz dykes. The Neogene volcanism is represented by basaltic rocks of the Campos de Calatrava magmatism, which are found to the southeast of the region.

Cenozoic (Tertiary and Quaternary) sedimentary materials cover the crystalline basement. These materials are represented by: floodplain deposits and fluvial terraces of the Guadiana River and its tributary streams; slope and colluvial deposits, predominantly formed by conglomerates, some of which with a high quartzite component (known as "raña"); and alluvial deposits, associated with recent fluvial sediments.

5.2 Petrographic characteristics of stelae in the Zújar valley

The materials used for the stelae supports of the Zújar valley were extraordinarily varied (Fig. 8 and 9), although mostly quartzite-types have been described in most of the findings (36). More scarcely, engravings have also been found in felsic igneous rocks: granites (12), aplite (1) and granite porphyries (2); meta-sedimentary rocks: schists/slates (6) and hornfels (1); diverse sedimentary rocks: (meta-)psammites (11) and conglomerate (1); and, more sparsely, in basic to intermediate igneous rocks: basalts (2) and dacite (1). Petrographic studies on the stelae were carried out in the distinct museums using a portable binocular (see 3). Likewise, given the high number of stelae described in quartzite-like support, a geological sampling was carried out in the Capilla region for comparison with local outcrops (Fig. 10; Table 3). The mesoscopic study of the stelae revealed the following petrographic characteristics:

The stelae from Capilla I, VIII, IX and X (Es 23, Es 27, Es 21 and Es 20) and Valdetorres I (Es 30; Fig. 9 B) are classified as isotropic and homogeneous siliceous sandstones (quartz-arenites or silicate cemented quartz-sandstones (so-called ortho-quartzite) of fine to medium grain size, without visible lamination or with a very fine parallel lamination, and showing ripple-type current structures. They are mostly composed of quartz (>90 vol%) with feldspars, and accessory garnet, tourmaline, chlorite, hematite or magnetite. Regarding the Valdetorres I stela, the presence of magnetite may indicate low diagenetic maturity. However, the presence of siliceous cement and intergranu-

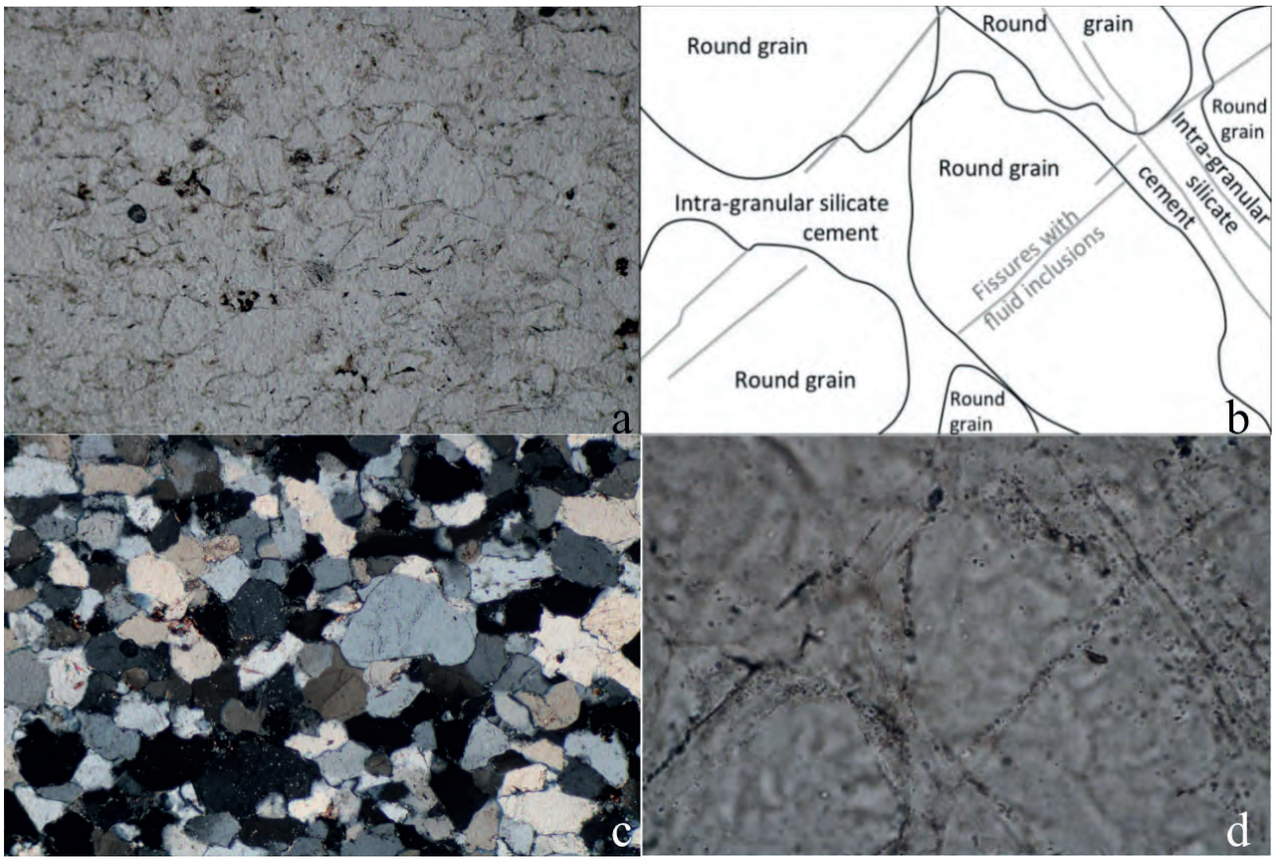

Figure 10. Microphotographs showing the petrographic characteristics of samples Es 11 a. and c. Quartz-sandstone Es 11 composed of sub-rounded quartz grains and sub-angular feldspar crystals, whose porosity is filled by intergranular and intersertal silica cement, indicating a moderate degree of maturity. There are detrital muscovite crystals or included in quartz, and hematite filling some pores (figure length 5,5 mm, 50x magnification). b. and d. Detail of Es 10: rounded quartz grains between which an intragranular silicate cement crystallizes, indicating a high diagenetic degree (mesogenesis) (figure length 0,25 mm, 800x magnification). (Microphotographs. R. Ferreiro Mählmann).

lar quartz, as well as the crystallization of quartz in fissures and veins, suggest a high level of diagenetic grade or very low-temperature metamorphism in all of these stelae (< 230 °C; for example, Marfil and Caja 2010; Araque Gonzalez *et al.* 2023).

The supports of the stelae from El Viso IV (Es 25) and Belalcázar I (Es 24; Fig. 9 D) present petrographic characteristics similar to those described in the previous stelae (Table 3). However, the visible recrystallization of hematite to magnetite suggests that they were affected by low-temperature metamorphism (around 300 ºC, at sub-greenschist facies; Winter, 2001). Therefore, these stelae could be classified as (meta-) quartzite or as meta-quartz-arenites.

The Capilla IV stela (Es 29) consists of a fine-grained impure quartzite (feldspar-bearing quartzite), recrystallized, showing a poorly developed stratification. Although the quartz and feldspars do not show elongation or preferential orientation, the microstructure is very irregular and its diablastic appearance suggests contact metamorphism.

The stelae from Villar de Rena (Es 19) and Cabeza del Buey II (Es 31), previously classified as quartzite, were actually engraved in meta-psammite rocks. The Villar de Rena stela, mesoscopically identifiable, is a fine- to medium-grained, dense and massive sandstone with subparallel foliation that may indicate a slaty cleavage (flaser form) or parallel layering with pressure-dissolution textures. The support is primarily composed of quartz and feldspar, although micaceous minerals (muscovite/sericite) and chlorite are also identified, as well as magnetite and rock fragments (lithic clasts). The quartz exhibits brittle-ductile deformation textures parallel to the foliation (mineral blastesis, elongation, and recrystallization), indicating incipient metamorphism (metagenesis). These characteristics suggest that the rocks are meta-arkoses or lithic meta-arenites.

Other stelae analysed in the region are made of diverse types of metasedimentary and igneous rocks. The support of the Benquerencia de la Serena stela (Es 26; Fig. 9 C) is classified as nodded schist. The rock exhibits a penetrative schistosity and a well-developed lepidoblastic texture. This texture is formed by parallel planes of micaceous minerals, with stretched quartz crystals and nodules (known as "fly") of probably andalusite ± cordierite origin that have been completely replaced by micaceous minerals. These features indicate a contact metamorphism of the greenschist to amphibolite facies (low pressure / high temperature; Bucher and Frey 1994).

The Capilla XI stela (Es 17) is a fine- to medium-grained holocrystalline porphyritic igneous rock, composed mainly of quartz, potassium feldspar (orthoclase and microcline) and plagioclase. Accessory minerals include muscovite, biotite, haematite and hornblende. The Capilla XII stela (Es 18) is a porphyritic igneous rock with phenocrysts of plagioclase and crystals of quartz, biotite, hornblende, and magnetite within an aphanitic to microcrystalline matrix. A magmatic flow in the form of schlieren and preferential crystalline orientation can be distinguished. Therefore, the Capilla XI and Capilla XII stelae, both found reused at the Tabla de las Cañas site in the La Serena reservoir, consist of hypabyssal rocks and are classified as a granophyre (granite porphyry) and a dacite porphyry, respectively.

Table 3. Results from stela and outcrops in Spain. It must be noted that in most cases, only those stelae where microscopic analyses were conducted could be classified. Exceptions to this are the stelae of Capilla I, VIII, IX and X, which could be attributed to sampled outcrops based on the mesoscopic data, and Monte Blanco (Olivenza), which could be classified without sampling. All other mesoscopic analyses remain preliminary and require confirmation (all analyses by R. Ferreiro Mählmann).
Abbreviations: silic. = silicates, * = interpret as the former recrystallized clay matrix. Sample identification: Es = Spain, Po = Portugal. Other abbreviations see table 1.

					Main minerals			
Name	**No**	**Scope**	**Lithotype**	**Class**	**Qz vol%**	**Feldspars vol%**	**Other Minerals vol%**	**Comment**
Stelae from the Zújar and Guadiana valleys (Extremadura, Spain and Alentejo, Portugal)								
Belálcazar I, El Mato	Es 24	Meso	Silicate quartz arenite	Very hard	>90	No microscopic data		
Benquerencia de la Serena	Es 26	Meso	Nodded schist	Med.	No microscopic data			fractural
Capilla I,La Moraleja	Es 23	Meso	Silicate quartz arenite	Very hard	98	1	1 lithic cl.	Outcrop Es 10
Capilla IV,Vega de San Míguel	Es 29	Meso	Silicate quartz arenite	Very hard	>90	No microscopic data		Outcrop Es 09
Capilla VIII, La Pimienta	Es 27	Meso	Silicate quartz arenite	Very hard	98	1	1 lithic cl.	Outcrop Es 10
Capilla IX, Piedrasanta 1	Es 20	Meso	Silicate quartz arenite	Very hard	95	5	-	Outcrop Es 11
Capilla X, Piedrasanta 2	Es 21	Meso	Silicate quartz arenite	Very hard	95	5	-	Outcrop Es 11
Capilla XI, Tabla de las Canas 1	Es 17	Meso	Granophyre	Hard	>40	>50	1 Mica 5 Others	Preliminary determined, Syenogranite
Capilla XII,Tabla de las Canas 2	Es 18	Meso	Dacite ? According xenocrystals	Med.	>20	No microscopic data		Preliminary determined
El Oreganal, Torrejón el Rubio II	Es 01	Micro	Meta-wacke	Med. to soft	31	5	8 lithic cl.49* Sheet silic.	Sheet silicates form the clay
Monte Blanco, Olivenza	Es 28	Meso	Calcareous sandstone	Soft	No microscopic data			99 % of the clasts are Qz
Negrões, Castro Verde (Portugal)	Po 64	Micro	Lithic wacke	Med.	40	28	31 lithic cl.	25 vol% matrix
El Viso IV, La Solanilla	Es 25	Meso	Silicate quartz arenite	Very hard	>90	No microscopic data		Preliminary determined
Valdetorres I	Es 30	Meso	Silicate quartz arenite	Very hard	>90	No microscopic data		Preliminary determined
Villar de Rena	Es 19	Meso	Chlorite-meta-arkoses lithic arenite?	Med. to soft	No microscopic data			Preliminary determined
Outcrops in the Sierra de la Moraleja, Zújar valley (Extemadura, Spain)								
Capilla Es 09	Es 09	Micro	Silicate quartz arenite	Very hard	95	1	4 lithic cl.	Capilla, several stelae
Capilla Es 10	Es 10	Micro	Silicate quartz arenite	Very hard	98	1	1 lithic cl.	Capilla, several stelae
Capilla Es 11	Es 11	Micro	Silicate quartz arenite	Very hard	95	5	-	Capilla, several stelae

5.3 Discussion of the Zújar valley stelae

The materials commonly used for carving the studied stelae can be classified into three groups of rocks with similar mineralogy: quartzite to quartz-arenites; arkoses to lithic arenites; and plutonic to hypabyssal granite rocks. There are also some minor supports engraved on meta-sedimentary lithologies such as meta-psammites, slates/schists, and hornfels, as well as on conglomeratic and basic volcanic/sub-volcanic rocks (Fig. 8).

Presumably, the source area should not be far away from the stela findings and could be related to the surrounding lithostratigraphic units. This is especially true in cases where there has been no subsequent transport or reuse. Most of the lithologies used for carving the studied warrior stelae crop out within the Central Iberian Zone, where the majority of the finds are located (Fig. 8). On the contrary, the high degree of metamorphism recorded in the Ossa-Morena Zone rules out the possibility of the lithologies found in that area serving as source regions.

The quartzite and quartz arenite stelae generally resemble certain Palaeozoic stratigraphic units of the CZI, particularly from the Lower to Middle Ordovician (Armorican Quartzite and/or Pochico beds). However, it is also possible that they belong to similar lithologies from other Upper Ordovician, Silurian or Devonian formations. The geological sampling and microscopic study conducted on various lithologies from the CIZ, including quartzite, silicate quartz-arenites, and arkoses rocks, suggest that the stelae supports were primarily sourced from the Lower to Middle Ordovician formations in the Capilla region.

The mesoscopic features of the stelae from Capilla I and VIII (Es 23 and Es 27) and from Capilla IX and X (Es 21 and Es 20) are likely similar to those found in the quartz-arenite lithologies Es 10 and Es 11, respectively (Table 2; Fig. 10; see Araque Gonzalez *et al.*, this volume), which belongs to the Pochico Beds, both discovered in the Sierra de la Moraleja on top of the Armorican Quartzite. It is likely that other stelae found in the same region were carved in similar materials. However, experiments conducted on similar quartz arenite lithologies (Table 2) indicate that they could not have been utilized as tools for engraving the stelae due to surface fragmentation and differing carving lines. The Valdetorres I stela (Es 30; Fig. 9 B) and other stelae discovered north of the Zújar valley were found near outcrops of Ordovician quartzite and quartz-arenite rocks. This suggests that similar materials from the vicinity of the Guadiana River were used for stelae engraving. This study raises the question of whether all stelae classified as quartzite were sourced from the Armorican Quartzite, as was commonly assumed. It highlights the need for more detailed meso- and microscopic studies to determine the provenance of these materials.

Regarding the stelae engraved on (meta-) psammitic rocks, their origin may be linked to the materials of the Schist-Greywacke Complex (SGC). In fact, most stelae were found to be made of these materials (Fig. 8; Celestino Pérez and Paniego 2021). However, there are also (meta-) psammitic materials present in the Palaeozoic sedimentary sequences, alternating with other sedimentary lithotypes. Therefore, they cannot be ruled out as possible quarries.

Concerning the Magacela II stela (M2 in Fig. 8; Fig. 9 A), which is engraved in a conglomerate, the presence of clay, slate, and granite cobbles indicates that its source material was probably related to Quaternary sediments from the Guadiana basin. These sediments consist of coarse cemented detrital facies resulted from the erosion of the crystalline basement.

The stelae with contact metamorphic textures, such as hornfels, nodded slates and/or schists, were likely sourced from the thermal metamorphism halo generated by the intrusion of granite plutons into older (meta-)sedimentary rocks. Such would be the case of the Benquerencia de la Serena stela (Es 26), found in the vicinity of Ordovician sedimentary rocks affected by contact metamorphism (Martínez Poyatos *et al.* 2001) induced by the Los Pedroches Batholith (BP; Fig. 8). In fact, some quartzite stelae found in the Zújar valley (e.g., Belalcázar I and El Viso IV; Es 24 and Es 25; Fig. 8) may consist of quartz-arenites that have undergone contact metamorphism, as evidenced by their incipient metamorphic grade. It is worth noting that to the north of the Capilla area, there are indications of thermal impact on sedimentary rocks (sandstones and pelites) near the Garlitos pluton (IGME 1987b). Therefore, these materials may have been sourced from rocks affected by the intrusion of this granite body.

Stelae engraved in granitic rocks are typically found near outcrops of acidic plutonic bodies (granitoids), suggesting they were made from local materials (Fig. 8). Stela supports were also sourced from acidic to intermediate subvolcanic rocks (granite porphyries, aplites and dacite porphyries) and basic volcanic rocks (basalts). However, locating these latter lithologies in the field can be more challenging. The lack of detailed meso- and microscopic studies on exposed lithotypes hinders our ability to identify potential source areas. Hence, any suggestions must be based solely on the geological maps of the region surrounding the discoveries. Felsic hypabyssal bodies are commonly found crosscutting the BP, particularly in the Hinojosa del Duque region (e.g., IGME; Fig. 8), as well as in the Precambrian basement of the SGC near the Almadén region (IGME 1987a). Similarly, basic to intermediate subvolcanic rocks intruding the SGC occur near Cabeza del Buey and

the La Serena reservoir. Finally, the support of the basaltic stelae (Almodóvar del Campo II and IV; AC2 and AC4 in Fig. 8) was likely obtained from the Neogene basic volcanic materials of the Los Campos de Calatrava region, located southeast of the study area, although they may also be sourced from other Palaeozoic basic lithologies described in the Almadén region.

6. Results

In both study areas, namely the Portuguese Beira Interior in the North and the Zújar valley in Spanish Extremadura in the south, this study revealed clear preferences of specific rocks for the making of stelae, which are based on the technical properties of these materials. Furthermore, in both these study areas, it could be confirmed in all provenance studies that have been conducted that none of the rocks has been transported over greater distances than 5 km (see Baptista *et al.*, this volume). This demonstrates that local resources have been used and the stelae were presumably erected near the outcrops, showing a deep knowledge of the territory that goes beyond the immediate surroundings of the settlements. The choice of the rock types that were carved shows that the FBA-EIA artisans were well aware of the most suitable slabs and their properties, however they had a preference of harder materials over softer rocks from the surroundings in both areas.

In the Portuguese Beira Interior, porphyry granitoids, including coarse to medium-grained muscovite syenogranite compositions represent more than 98 % of the batholiths and plutons in the region. Nevertheless, these porphyry rocks were only in one single occasion used for making a stela (Pedra Atalaia 1, Po 63), and medium to coarse grained plutonic rocks in two other occasions (Telhado, Po 08 and Corgas, Po 07). The coarse to very coarse grain size of many plutons, specifically of feldspar phenocrysts, was probably recognized as a hindering factor for carving precise lines, because large feldspar crystals would break out and render the lines irregular, or require the making of very broad lines top equilibrate this effect (Fig. 11). In addition, it must be said that Pedra Atalaia is located in the Beira Alta, north of the region with the highest stelae concentration. Telhado and Corgas are located further to the South near Fundão, in the Beira Baixa; however, both monuments are hiatal but not coarse porphyry.

The overwhelming majority from the Beira Interior and most of the analysed granitoid stelae in Spain are made from different magmatic rock types than the porphyry plutons. The preferred magmatic rocks all share the following features: they were leucocratic, fine to medium grained, isotropic, uniform granular to serial, interlobate granular, and quartz rich (> 25 vol%). These rocks originate from

Figure 11. Exemplary drawing of a hypothetic circular design for engraving on a porphyry granitoid (on the material of Pedra da Atalaia 1). The drawing does not represent (or cover) an actual motif but indicates the hypothetical line drawn around feldspar crystals that would cause possible outbreaks when a round line would be carved into this surface (Photographs: R. Araque Gonzalez, drawing: R. Ferreiro Mählmann).

an apophysis (small pluton) or an aplite (dyke rock) and pertain to one of two types: firstly, two-mica syenogranites with a high dominance of Ms (white mica) over Bt (black mica), and therefore they are very light coloured; secondly, muscovite syenogranites.

The reasons for the choice by prehistoric artisans were seemingly practical as well as aesthetic. The high visibility of these leucocratic dykes in contrast to surrounding darker, grey quartz diorites, granodiorites, and monzogranites was most probably an important factor to attract their attention. Quartz rich syenogranites have a higher weathering resistance and are harder than the monzogranite plutons. In summary, these rocks can be classified as hard to (rarely) medium hard (see Table 1). Moreover, the fracture structure of these rocks is mostly parallel to strike of the dykes, for example in Lajeiras. In the apophysis of Barrocal, an orthogonal cooling fracture system predefined slabs of suitable size for the stela. To illustrate the incentive to use these fissured rocks for stelae as soon as this concept of rock art was established, there are still dispersed leucocratic granitoid slabs of the granitic Beira landscape (Fig. 12).

The choice of sedimentary and meta-sedimentary rocks for stelae in the Beira at Fóios, Meimão and Zebros followed particular material preferences and it is evident that artisans used the most appropriate material. The predominant rocks in these areas are soft, clay mineral or mica rich rocks with silt to sand layers, such as wackes, mudstones, slates and shales. On the other hand, the meta-psammites (sub-arkoses, arkoses and arenites) could be determined as the hardest meta-sedimentary rocks in these areas and those were used for the stelae. The most striking characteristic is the preferred use of plane hard grounds or bedding planes with a siliceous matrix or silicate cement for the engravings.

Figure 12. Fissured leucoctratic granite slab at Cabeço do Cornelho in Portugal (Photographs:: R. Araque). This particular slab is porphyric and not fine-grained, hence it could not be used for our stela replication. Before the extensive quarrying of aplite and fine-grained granitoids, artisans could obtain suitable slabs in this format for their stelae.

Furthermore, these rocks had to be isotropic and their carving was not obstructed by mineralogical (e.g. sheet silicate layers), grain size (e.g. graded bedding, conglomerate components, fine grained matrix) or sedimentary structural and tectonic inhomogeinity of low cohesion (solution sutures, sedimentary hiatus, banding, foliation, slaty cleavage, schistosity).

This connects the sedimentary rock preferences in the Beira to the choices made in the Zújar and Guadiana valleys further south in Spain. However, the predominantly used rocks in the Zújar basin around Capilla were often extremely hard silicate quartz-arenites and possibly also some hydrothermal quarzitic rocks. In all studied cases, the sedimentary and meta-sedimentary lithotypes were chosen according to criteria such as the lowest potential to break into small pieces and used platy blocks that were easy to exploit by breaking naturally along sedimentary or tectonic foliations. Slabs with a hard ground and sometimes with river-rounded surfaces were clearly preferred. In summary, it can be stated that firstly, an excellent knowledge of the material was required and prevalent when selecting the appropriate stones. The reason for this is that the lithological composition has direct consequences for the sculptural qualities.

With relevance to the replication experiments (see Araque Gonzalez *et al.* this volume), the criteria for their choice were an identical lithotype, hardness, microstructure and grain size to compare the workability. The rock that was chosen to re-make the stela of Baraçal 2 from the Lajeiras aplite (Po 13) is representative of the original in terms of its physical properties. For the second experimental stela that was carved after the original from Fóios (Po 24/Po 25) an equivalent rock type was used from the same sedimentary outcropping, found along 4 km along the Côa river, with a corresponding silt to sand grain size sub-arkoses and identical in mineral composition and microstructure to the rock of the stela. The only difference between the rocks of copy and original was a transformation of chlorite and feldspar to biotite (8 vol%), while in the Fóios stela biotite was not detected and the rock appears to have been sourced from the chlorite zone of the contact metamorphic cordierite/andalusite facies to sub-greenschist facies field gradient. The experimental stela has a higher metamorphic grade (biotite zone) than the original from Fóios (Döbler *et al.* in press). However, the difference of biotite to chlorite does not cause a physical difference for the workability of the rocks.

The replications of the stelae from Capilla were conducted with rocks that were obtained from the same outcrops as the stelae in the Sierra de la Moraleja (see Araque Gonzalez *et al.* 2023). In summary, the stelae that were used for the experiments have all been confirmed to be representative for the originals by the detection of their provenance and the petrographic and (in Portugal) geochemical studies. Therefore, the validity of the comparison could be confirmed.

7. Discussion: choices, extraction and workability of hard rocks

According to the results, it is evident that in both study areas hard and frequently the hardest possible rocks were used for the stelae. The hardest rock of magmatic provenience is the aplite that was used for Aldeia Velha, however the hardest rocks for stelae were used in Capilla and the Zújar area. Contrastingly, the sedimentary and meta-sedimentary rocks that were used for the stelae in Fóios, Meimão and Zebros are only medium hard to soft (see Table 1 & 2).

The raw material for the stelae made of granite rocks, especially aplite, had particular material properties that might have influenced the significance of the monuments. Some technical-mechanical features could be detected from the analyses of the granitoids. In the rocks used for Baraçal 2 (Po 30) and its equivalent, Lajeiras (Po 13), the hardness is influenced by the very high feldspar content

(albite, orthoclase). The microstructure of the embedding of quartz in feldspars (intergranular to intragranular), the fine to medium grain size, and the uniform granularity allow for the carving of precise lines and fine ornaments. The quartz can be easily broken out of the granular polygonal microstructure.

In comparison, the rock used for the stela of Baraçal 1 has a lower abrasion resistance, hence it is a relatively soft granite. This can be explained by the polygonal granular grain structure with 19 vol% mica, which causes mechanical weakening. This explains the more advanced state of erosion of the stela. Together with the hydrothermal alteration lowering the cohesion (Fig. 5e), this technical predestination might have led to the artisans deciding to decorate Baraçal 1with a high relief. This style of carving is very uncommon for the FBA-EIA stelae, where it is only found in Baraçal 1 and two odd outlying examples in southern France (Celestino Pérez 2001, 449-451). On the other hand, it is typical for the MBA Alentejana stelae in Portugal and statue-menhirs, for example Corgas (Po 07), which shows a similar microstructural pattern of secondary softening alteration.

The quarrying of fissured granite slabs is still being practiced with archaic methods in the Alps (for example, in Ticino, Switzerland; R. Ferreiro Mählmann pers. Comm.) and different French regions (Leandri, Peche-Quilichini and Cesari 2019, 37). Typically, the fissures are broken out with iron, stone or wooden wedges and water. The basic shape of these human "life-size" (ca. 1.50-1.90 m) to "larger-than-life" (for example Telhado in Portugal measures 2.70 m) slabs was already predetermined by the fissured rock and made them ideal for working them into stelae and statue-menhirs. The slabs were correspondingly heavy (approx. 0.5-1.5 tons). They were painstaking to transport and required a larger group of people or the help of animals. It stands to reason that the symbolic and defining images of weaponry, mirrors and ornaments only had to be carved out from the stone once a suitable candidate had been determined.

The effort behind making a granitoid stela must have been obvious to other contemporary people and it can be assumed that these monuments were given due respect. Seemingly, the sculptors of these monuments had an aesthetic preference for light-coloured, fine-grained rocks. In summary, the quarrying, shape and surface preparation, carving, and erection of a granitoid stela were communal, social as well as socializing activities, which could be interpreted as identity-building acts that enforced a communities' sense of belonging.

On the other hand, the deposits from where rocks for stelae made of (meta-) sedimentary rocks have been sourced are concentrated in limited areas along rivers such as in our study areas for example the Rio Côa near Fóios, Ribeira da Rata in Zebros and in the Serra de Malcata in Portugal, and along the Zújar river in Spain. The originate from horizontally bedded or vertically dislocated sediments. The deposits are concentrated in limited areas, which facilitates the identification of possible quarries.

Excellent knowledge of the material was required when selecting the sedimentary rocks, as the processing of the stratification can easily destroy the chosen slab if the bearings are incorrectly selected. They were sometimes smaller (on average 1 m high) and consequently lighter than the chosen granitoid slabs and thus easier to transport. A basic form with a flat surface as a projection screen for motifs was provided by the slabs, which was ready to carve. Therefore, some probably communal aspects of stelae-making that prevailed for the granitoid monuments, such as polishing, were not required for the sedimentary rock stelae.

Returning to the hardest specimens from the silicate quartz-arenites in the Zújar valley, the very fine to fine grain size allowed to carve precise lines in the isotropic rocks of Capilla I, II, III, and VIII. On the other hand, the fine bedding, graded bedding, and different grades of silicate cement found in layers in Capilla X and XI caused flat, thin-foliaceous negative forms of detached cuts, which might be partly a product of stone working but probably a result of weathering. The fine difference in bedding and composition to the other stelae from Capilla explains the inferior workability of this lithotype, as well as the poorer preservation of the engravings. Probably, the silicate quartz sandstone was preferred for rock art carving over the anisotropic Armorican quartzite because it allows for a much more precise carving of lines due to the microstructure. In summary, a greater variety of lithotypes were used in Extremadura (Spain) compared to the Beira Interior, however the number of stelae there is far smaller. The artisans of the Zújar basin had an aesthetic preference for the reddish hard ground silicate quartz arenites and the bright, clear, contrasting lines that can be carved into it.

In conclusion, due to their wealth of knowledge, the artisans who made the stelae consciously chose the rocks that were favourable for sculpting and engraving for their physical properties. Despite the availability of softer rocks in the Portuguese Beira Interior as well as in Spanish Extremadura, the artisans seemingly preferred the hardest rocks. The symbolic significance of the monuments must have exceeded the actual images by far: in a society which is aware of the physical properties of the surrounding natural materials, the craftspeople who were able to adorn the hardest rocks with powerful symbols would have certainly been the most respected. The choice of a certain rock-type

for a stela and its deliberate positioning in the landscape was almost certainly just as important as the composition of the images. Therefore, it is essential to consider the different technical properties of the rocks that were used and the necessary tools to carve them and adorn them with portentous symbols.

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CHAPTER 8

Stelae and landscape at the Western Iberian Central System during the Late Bronze Age

Marcos Osório, Pedro Baptista and *Raquel Vilaça*

Abstract

The authors seek to outline the main aspects of the occupation of the westernmost area of the Iberian Central System, consisting, from East to West, of the Gata, Malcata, Estrela and Gardunha mountain ranges, during the transition between the 2nd to the 1st millennium BC.

The approach revolves around "stelae": stone monuments that not only marked specific places in their territory, but continuously (re)built their own landscapes. They amount to about a dozen, located, mostly, around the mountain edges, and while apparently isolated, deeply connected to the settlements, the true references of the living experiences of these communities.

The study will tackle different aspects inherent to stelae, with emphasis on those of spatial and territorial nature, namely the relationship between its raw materials and the regional lithology, and, at the same time, between these monuments and the proximity / distance to the most critical resource at the time: metal. The studied region is particularly rich in copper, tin, and gold mineral resources, available both in veins and in alluvium, and the stelae depict it in a figurative and sublime way, through weapons and other assets of power.

Keywords: Landscape Archaeology; Geographical Information Systems; Beira Interior; Local bedrock; Copper / Tin ore deposits; Settlements.

Resumo

Na área mais ocidental da Cordilheira Central Ibérica, pontuada, de leste para oeste, pelas serras da Gata, Malcata, Estrela e Gardunha, os autores procuram esclarecer os aspetos fundamentais que caracterizaram a ocupação humana deste território no período de transição do II para o I milénio a.C.

A abordagem centra-se nas "estelas" - monumentos de pedra que não só assinalavam lugares específicos no seu território, mas continuamente (re)construíam as suas próprias paisagens. Resumem-se a cerca de uma dúzia, localizadas principalmente na periferia das montanhas e, embora aparentemente isoladas, estão intrinsecamente ligadas aos núcleos habitacionais, as verdadeiras referências da vida destas comunidades.

O estudo abordará diferentes aspetos inerentes às estelas, com particular ênfase nos de natureza espacial e territorial, nomeadamente a relação entre as suas matérias-primas e a litologia regional e, ao mesmo tempo, entre esses monumentos e a proximidade ou afastamento do recurso mais crítico da época: o metal.

Com efeito, a região estudada é particularmente rica em recursos minerais de cobre, estanho e ouro, disponíveis tanto em veios como em aluvião, e as estelas representam tal riqueza de uma forma figurativa e sublime, através do armamento e outros bens representativos do poder.

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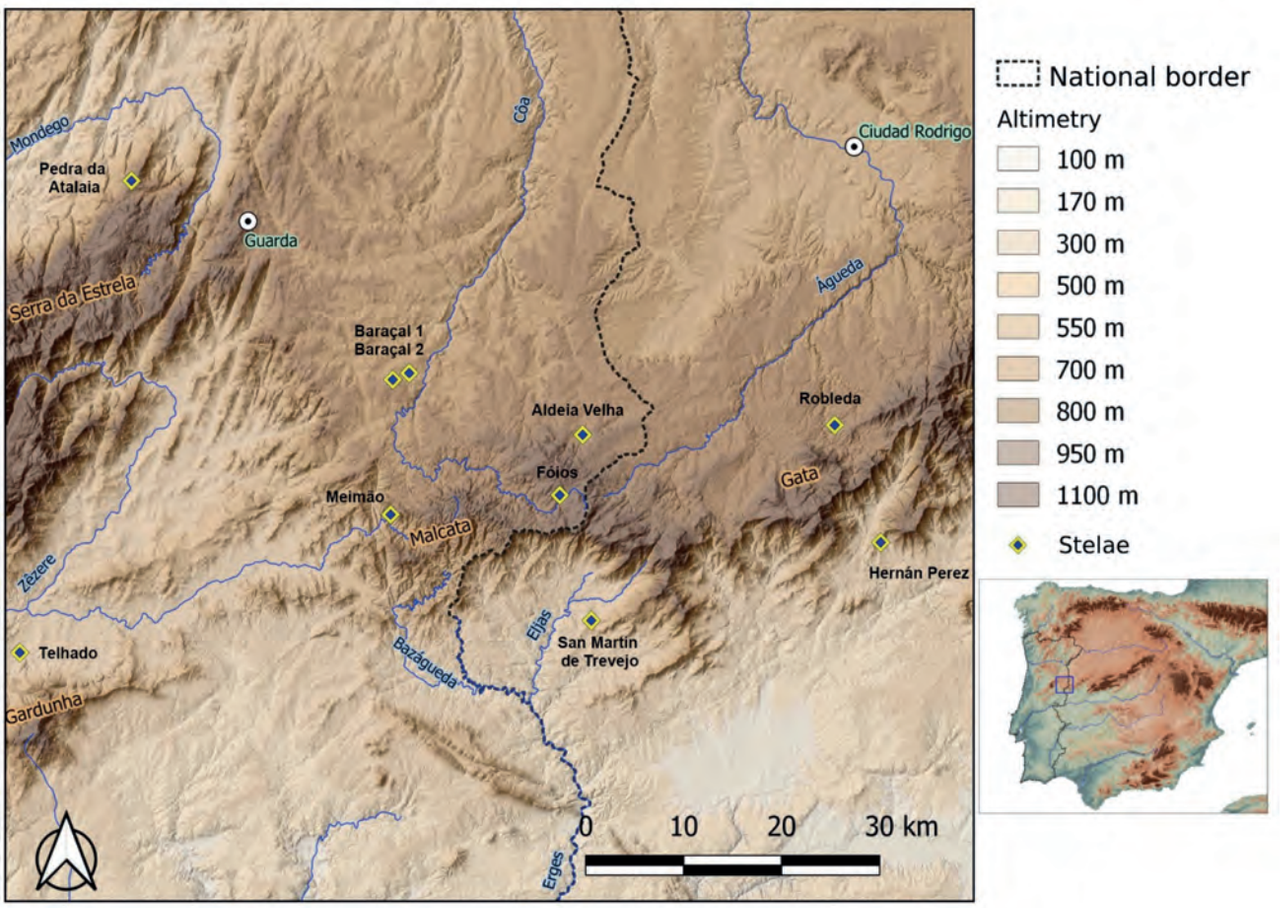

Figure 1. Location of the western Iberian stelae within the study area. In the inset, the location of the study area within the Iberian Peninsula. (Map: M. Osório)

Palavras-chave: Arqueologia da Paisagem; Sistemas de Informação Geográfica; Beira Interior; Substrato rochoso; Mineralizações de cobre e estanho; Povoados.

1. Introduction

Western Iberian stelae are among the most iconic archaeological remains of the Late Bronze Age (LBA, c. 1300-750 BC) in the Iberian Peninsula. These monuments correspond to standing stones ranging from c. 0.50 and 2.70m in height, and mainly depict swords, shields, and spears. Other objects are often represented, such as helmets, headdresses, mirrors, fibulae, combs, musical instruments, and chariots, as well as anthropomorphic figures and animals, sometimes displayed in scenes.

The overwhelming majority can be classified as isolated finds, missing a stratigraphic context. There are currently several active research lines, each with different approaches, objectives, and methodologies. However, one aspect that has been little explored, and which we address in this contribution, is the relationship between the location of these monuments and two potential locational factors: the local lithology and the proximity to metal ore deposits, specifically copper (Cu) and tin (Sn).

Following up on an earlier exploratory approach (Vilaça and Osório 2017), the westernmost part of the Iberian Central System, around the Gata, Malcata, Estrela and Gardunha mountain ranges, was chosen as a study area (Fig. 1).

In the past 15 years, the number of stelae identified in this area has increased considerably (Francisco 2019; Santos, Vilaça, and Marques 2011; Vilaça, Santos, and Gomes 2011; Vilaça, Osório, and Santos 2011; Vilaça 2021), defining a significant cluster of finds. So far, nine warrior stelae have been found in this territory (Fig. 2).

Additionally, according to some researchers, this region may correspond to the area of origin of this cultural phenomenon (e.g. Almagro Basch 1966, 198; Curado 1984, 81). This claim is based on several factors, such as the simpler iconographic compositions, the anthropomorphic character of the supports, in the tradition of statue-menhirs, and the particularity of the relief technique used in the Baraçal 1 stela (Santos, Vilaça, and Marques 2011, 330), similar to the Alentejano-type stelae, dated to the Middle Bronze Age (MBA, c. 1700-1300 BC). Over time, the phenomenon would have spread out, particularly southwards (Celestino Pérez 2001, 48–50; Celestino Pérez and Salgado Carmona 2011, 423; Curado 1986, 108),

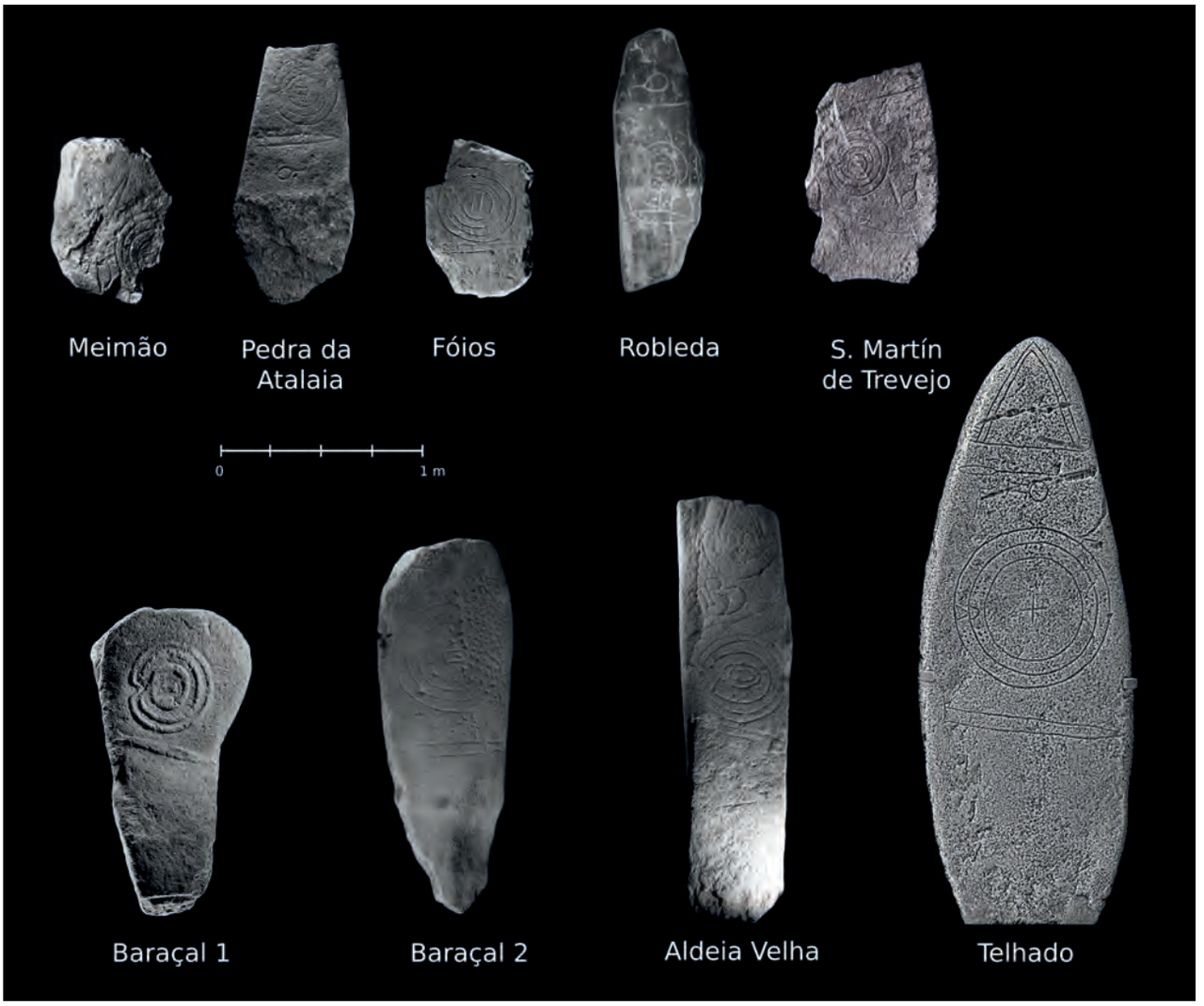

Figure 2. Western Iberian stelae discussed in the text. (Editing: M. Osório)

with an increase in the number and diversity of objects, and with the explicit representation of anthropomorphs through engraving. Other researchers (Alarcão 2001, 325; Barceló 1992, 269; Galán Domingo 1993, 78; Santos, Vilaça, and Marques 2011, 329) argue that these iconographic differences are a result of cultural and ideological factors, rather than of a chronological progression.

An important question arises then. Could cultural and ideological factors also have played a role in the location of stelae? Stelae, and prehistoric statuary in general, are distinguished from «fixed» rock art precisely because they do not depend on the existence of an ideal support in the chosen place, since one can be transported (Galán Domingo 2011, 273). In this sense, the location of the stelae would be the first choice, or at least «the most important».

Criteria for the selection of raw materials would then follow. Considering that this territory is characterized by the presence of the most monumental specimens (Celestino Pérez and Salgado Carmona 2011, 426), sometimes exceeding two meters in height, it is likely that the sources of the raw material were sought as close as possible to the chosen places, making the local bedrock an important factor in the selection of the support as well.

The spatial dimension of stelae has also been acknowledged and related to natural routes and ancient pathways (e.g. Galán Domingo 1993, 35–36), as well as to multiple strategic resources, such as water sources, farming fields, grazing lands, and metal ore deposits, the last of which particularly and abundantly found in the Beira Interior (Curado 1986, 108; Vilaça 1995, 71, 412, 420; 2013b, 35; Vilaça, Osório, and Santos 2011, 359).

1.1 On the relation between stelae and stone

Proximity, accessibility, ease of extraction, morphology, size, resistance, hardness, or visual contrast are all factors that converge in a single choice; that of the rock to be used for each stela.

As such, the petrological characterization of this type of monument goes beyond the mere determination of the lithotype, as it allows for a better understanding of the characteristics of the rock and how these condition its work-

ability, as well as to search for its provenance (see Ferreiro Mählmann *et al.*, this volume). In turn, through the lens of Landscape Archaeology, the establishment of provenances provides important data regarding past mobilities, the exploitation of the territory and the significance afforded by places from which raw materials were extracted (see Baptista, Araque Gonzalez, and Ferreiro Mählmann, this volume).

This kind of approach is necessarily interdisciplinary. Depending on the type of rock, different methods of mesoscopic, microscopic, and geochemical analysis contribute, complementarily, to understanding their formation and alteration processes. In turn, this allows to narrow down the possible Main Areas of Provenance (MAP). Through a deep knowledge of the surrounding territory and, in cases where geoarchaeological evidence allows, it is even possible to identify the Sources of Raw Material (SRM) (Carrión Méndez, García González, and Lozano Rodríguez 2006).

Specifically in the study of stelae, the early finding reports of these monuments summarily describe the raw material and establish a local provenance (Curado 1984, 83; 1986, 103; Figuerola 1982, 173), despite lacking a specialized geological evaluation.

Recent publications have countered this trend by advocating for a more holistic approach. Petrological cha-racterization and the corresponding determination of raw materials using petrographic and geochemical analyses have become increasingly recurrent aspects in the study of stelae, sometimes indicating local provenances (up to 10 km, but usually less), as in the cases of Arroyo Manzanas, La Estrella, Aldeanueva de San Bartolomé, and La Aldehuela (Toledo) (Merino Martínez *et al.* 2020), Mirasiviene (Seville) (Díaz-Guardamino *et al.* 2019), Almargen (Málaga) (Díaz-Guardamino *et al.* 2020), Capilla I / VIII (Badajoz) (Araque Gonzalez *et al.* 2023). In other cases, lithological determination pointed to exogenous sources, as exemplified by the stelae of Las Herencias (Toledo) (Meri-no Martínez *et al.* 2020) or Cañaveral de León (Rivera Jiménez *et al.* 2021).

1.2 On the relation between stelae and metal

The spatial association with mining occurrences finds a stronger tradition within the research of western Iberian stelae. Bronze, and its constituents, copper and tin, played a key role in the social dynamics of LBA communities, with an ever-increasing circulation of metal in vast exchange networks, between the Mediterranean and the Atlantic. In turn, these networks are evoked in stelae, as symbols of the artefacts that circulated in them.

The density of tin mineralizations has been associated with the Pedra Alta stela (Galicia) (Santos-Estévez *et al.* 2017, 72), or the tin and gold alluviums of the Tâmega river basin with the Castelões stelae (Chaves) (A. C. Silva *et al.* 2014, 627). Around San Cristobal de Logrosán (Cáceres), a settlement where there are clear indications of tin mining, the dispersion of stelae in the surrounding territory has been associated to tin occurrences or areas with agricultural potential (Rodríguez Díaz *et al.* 2014). Similarly, in the case of the concentration of stelae in the Zújar basin, in Capilla, the equally significant density of iron mineralizations is observed (Araque Gonzalez *et al.* 2023, 13).

Sometimes, the relationship between stelae and these resources is not direct but made through the communication routes through which they would be transported, as in the case of the association between the Beira Interior stelae and the coexistence of both copper and tin (Vilaça 2013c, 210), or between the Cañaveral de León stela and a passage corridor connected with the Sierra Morena and the important copper and iron mineralizations found therein (Rivera Jiménez *et al.* 2021).

2. Methodology

From a methodological perspective, our analysis explores two questions on a spatial meso-scale. Firstly, the relationship between the raw materials of the stelae and the bedrock available and the findspot, and secondly, between their locations and the distribution of copper and tin ore deposits. In both cases, the aim is to understand whether these natural factors influenced the locational strategies of these monuments.

While none of the stelae addressed here was found in a stratigraphic context, the findspot is taken as a potential primary context, except in the cases in which a clear transport and repurposing is known. The findspots were established based on the original find notices and through contact with the local populations.

The recently updated lithological classifications by Ferreiro Mählmann *et al.* (in this volume) were adopted for the stelae under analysis in Portuguese territory. For the remaining, we adopted the preliminary classifications presented in their respective publications, despite the lack of specialized geological characterization.

In turn, geological information on the territory was extracted from the Geological Map of Spain and Portugal, 1:1.000.000 scale (Rodríguez Fernández *et al.*2015); the Geological Map of Portugal, 1:200.000 (Sheet 4) (Meireles 2024) and 1:50.000 scale (Sheets 18-C, 21-A and 21-B) (Teixeira and Peres 1960; Teixeira *et al.* 1963; 1965); the Geological Map of Cáceres, 1:200.000 scale (Gumiel Martínez 2003), and the Geological Map of Spain, 1:50.000 scale (Sheet 573) (Garcia de Figuerola *et al.* 1985). These cartographic assets are open access and can be accessed through the LNEG and IGME official websites.

The survey of copper and tin mineralizations was carried out based on the SIORMINP (LNEG), BDMIN (IGME) and SIGEO (Junta de Extremadura) platforms. Specifically, for the municipality of Sabugal, it was possible to complement this information with the municipal licensing records.

As a caveat, this survey is based on records of mining occurrences carried out from the 19th century onwards for economic reasons in a specific historical context, being far removed from the incipient mining landscape of the 1st millennium BC. Establishing effective exploitation of these metal ore deposits during the LBA is a specific challenge, as different phases of mining activities, with successively more intensive methods, end up erasing previous traces (Osório and Marcos 2017, 17), and can only be overcome, in some cases, by indicators of previous mining activities, such as pre-existing mining-related toponymy (Jordá Bordehore, Puche Riart, and Mazadiego Martínez 2005, 29), archaeological finds (see Section 5) or archeometallurgical analyses, beyond the scope of this paper. As such, the resulting dataset can be understood as a distribution map of this type of raw materials, only potentially recognized and explored during the studied chronologies.

For both analyses, Geographic Information Systems (GIS) provide an ideal framework, as they allow for the georeferenced storage and articulation of both archaeological and geographical data (Wheatley and Gillings 2002). Successively, the collected data was integrated and processed with Qgis.

3. Natural setting

The relief line of the Iberian Central System (Gata and Malcata), which separates the plateau region of Guarda/Sabugal to the north from the Castelo Branco Platform to the south, constitutes the epicenter of a vast and heterogeneous territory known as Beira Interior in the Portuguese territory. Alongside the vast lands of Extremadura, the Beira Interior region encompasses an interfluvial space, where the basins of the two largest western Iberian rivers, the Douro and the Tagus, converge. Their tributaries almost intertwine, bringing the deep peninsular continentality to the doors of the western Atlantic. It is, therefore, a region of deep contrasts but also favorable to the establishment of contacts between people from various Iberian quadrants.

Between mountains and valleys that shape this territory, various natural passages structured the livelihood of communities 3000 years ago, bridging neighbouring regions (e.g. the Atlantic shore, the Meseta and the Alentejo / Southern Extremadura) and opening doors to other diverse and more distant cultural worlds, embodying one of the first phenomena of «ancient globalization» (Vilaça 2013a, 191) that, on an Afro-European scale, was designated «Pre-Modern globalization» (Vandkilde 2016).

This territory is integrated into the Hesperian Massif, a vast area of tectonic origin, deformed and retouched several times during the successive Hercynian and Alpine orogenies (Thadeu 1965, 7–9). The local topography is a result of these tectonic movements and subsequent erosion processes.

Tangential and vertical forces acted within the Meseta and raised this mass in the Pliocene, a uplift that did not manifest with the same intensity everywhere, as it is deformed and cut by faults, giving rise to subsequent orographic folds of the Gata, Malcata, and Estrela mountain ranges (Ribeiro, Lautensach, and Daveau 1987, 8 and 146), which constitute the most representative reliefs of this territorial unit, contrasting deep and sinuous valleys with imposing elevations.

Two major geological units come into contact here (Fig. 3). The Neoproterozoic Schist-Greywacke Complex Beira Supergroup, prevalent in the South, is the oldest in the region, and is constituted by a lithological sequence of metagreywackes, slates and metaconglomerates (see Meireles *et al.* 2022, 3 with further bibliography).

The other major geological mass consists of biotite monzonitic granite, constituting the dominant surface (Teixeira *et al.* 1963, 11), which emerged more recently during the great Hercynian intrusion at the end of the Carboniferous (Teixeira *et al.* 1963, 23). Two types of granites are distinguished by their morphology and texture: porphyritic granite, generally coarse grained (more widespread), and non-porphyritic granite, medium/fine grained (in small sinuous patches) (Gonçalves and Assunção 1966, 13). Although they present variations in texture and granularity, they exhibit a constant mineralogical composition, of the monzonitic type, with white or black mica, predominating quartz or feldspar. The porphyritic granite blocks acquire more chaotic shapes and larger dimensions, while the non-porphyritic granite blocks are smaller (Thadeu 1965, 21; Ramos and Oliveira 1982, 48; P. B. Silva 2014, 62).

The most frequent mineralizations occur in the quartz veins, predominantly oriented NE-SW / E-W, and embedded in Neoproterozoic and Cambrian metasedimentary rocks, and occasionally in Paleozoic materials and igneous rocks. The cassiterite veins are associated with the Hercynian orogeny in the Iberian massif, whereas copper, zinc, and lead veins are associated with post-Hercynian formations (Thadeu 1965, 32–33).

These mining resources are relatively abundant and diversified (Fig. 4). The gold and tin alluvial deposits of the Tagus basin, concentrated in the middle course of the Zêzere river, allowed for a more accessible exploration of these re-

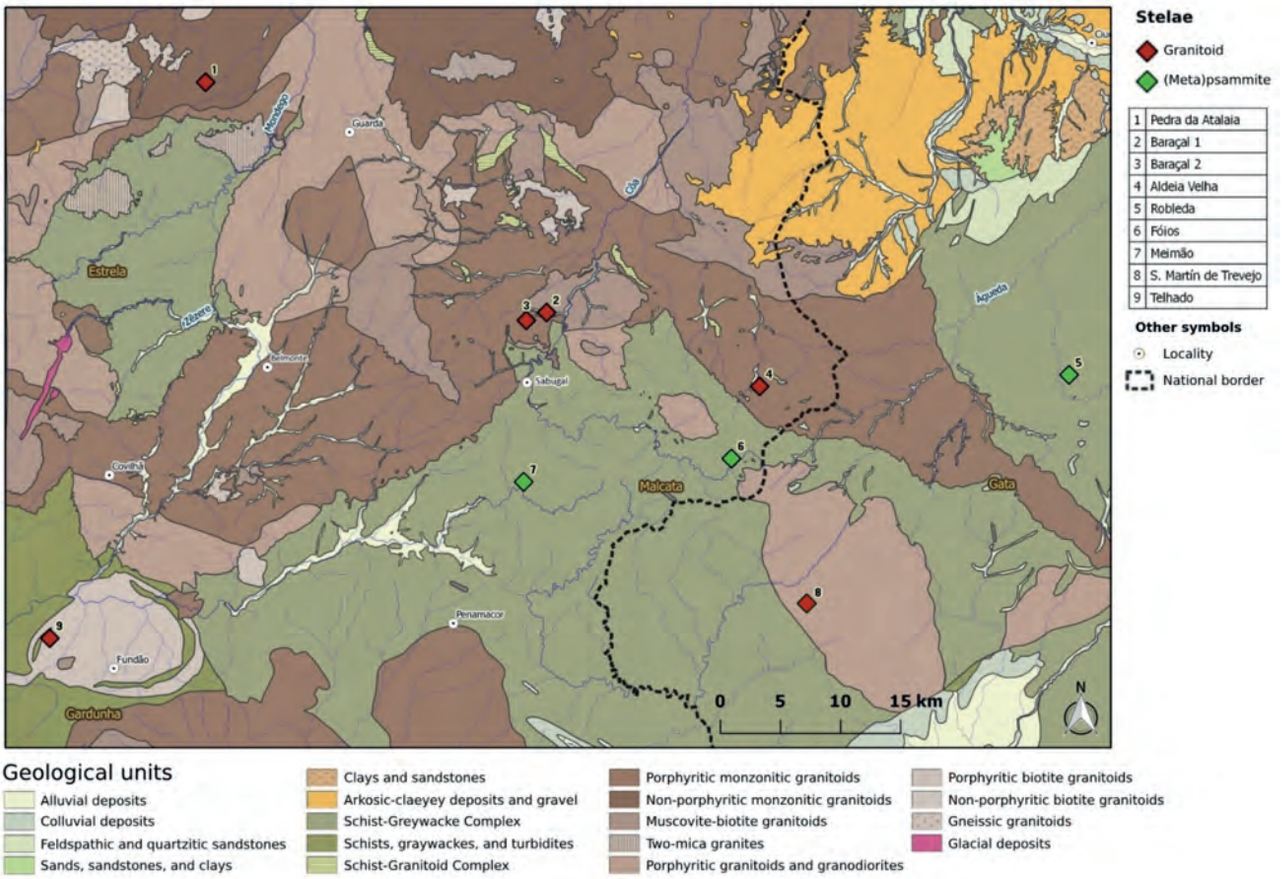

Fig. 3. Simplified geological map showing the location of western Iberian stelae around the Western Iberian Central System. (Map: M. Osório)

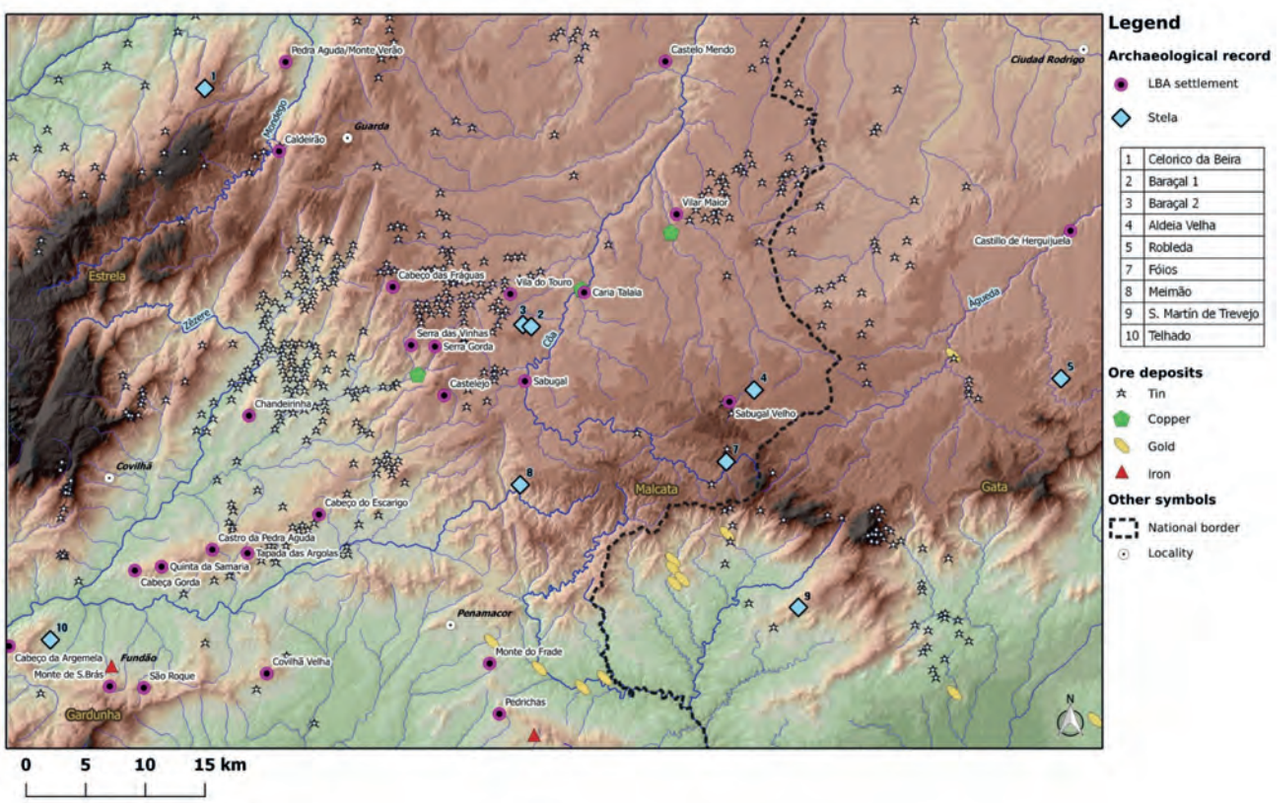

Figure 4. Simplified metallogenic (Au, Cu, Fe, Sn) map with the location of LBA settlements and western Iberian around the Western Iberian Central System. (Map: M. Osório)

sources (Allan 1965, 17–19; Domergue 1990, 41–42). A particularity of the Upper Côa reaches is the coexistence of these tin deposits with copper veins (Thadeu 1965, 32–33), some of which exposed in the surface as gossans, and providing both of the constituents of bronze in the same territory.

It is within this geographical framework that our approach is situated, which, in turn, focuses on one of the most interesting and powerful archaeological entities of the societies that lived in Beira Interior at the beginning of the 1st millennium BC, the so-called «warrior stelae».

4. Local lithology and raw materials

The lithological classification of the monuments was based on Ferreiro Mählmann *et al.* (in this volume), with the exception of the stelae from San Martín de Trevejo and Robleda, which were based on the information available in their publications (Figuerola 1982; Francisco 2019). They can be categorized into two main groups: granitoids and sedimentary rocks with a low degree of metamorphism (Table 1).

Aside from Aldeia Velha and Baraçal 2, each stela was found within a geological unit with the same general characteristics, showing a strong correlation between the local bedrock and the employed raw material (Fig. 3).

For the six granitoid monuments in the study area, one (Baraçal 2) is fine-grained; two are fine to medium-grained (Baraçal 1 and Aldeia Velha); one medium to coarse-grained (Telhado); and one coarse-grained (Pedra da Atalaia) (see Ferreiro Mählmann *et al.* this volume). The other, San Martín de Trevejo, has not been petrographically characterized.

Baraçal 1, Pedra da Atalaia, and Telhado were found in a geological unit with an equivalent grain-size, whereas Baraçal 2 and Aldeia Velha, which were repurposed and transported, show coarser-grain sizes in the local bedrock, distancing c. 0.8 km and 4.5 km from potential areas of provenance.

The specimen from Aldeia Velha was discovered in a significant area of coarse granite that extends 11 km to the north and 21 km to the east, with only a small area of non-porphyritic medium to fine-grained granite, 6 km away to the west (Fig. 5).

Table 1. Systematisation of the lithotype of the stelae, the bedrock at the findspots and the distance to the closest different geological unit.
*Repurposed in contemporary buildings. **No updated lithological classification.

Stela	Lithotype	Local bedrock	Min. distance to a dif. geological unit
Aldeia Velha* (Sabugal)	Two mica syenogranite (Aplite)	Biotite-bearing porphyritic medium to coarse-grained granite	2 km SW
Baraçal 1 (Sabugal)	Two mica syenogranite (Aplite)	Two mica medium-grained granite	0.8 km SE
Baraçal 2* (Sabugal)	Leucocratic muscovite-syenogranite (Aplite)	Biotite-bearing porphyritic medium to coarse-grained granite	2.4 km S
Fóios (Sabugal)	Meta-sandstone-subarkose	Schist-Greywacke Complex	1.2 km SE
Meimão (Penamacor)	Quartzitic meta-greywacke	Schist-Greywacke Complex	5.7 km NW
Pedra da Atalaia (Celorico da Beira)	Quarzdiorite to granodiorite	Biotite-bearing porphyritic coarse-grained granite	3.1 km S
Robleda (Salamanca)	Slate**	Schist-Greywacke Complex	7.7 km W
San Martín de Trevejo (Cáceres)	Granitoid**	Fine to medium-grained granite	7.2 km W
Telhado (Fundão)	Biotite monzogranite / syenogranite	Medium-grained granitoid	600 m W

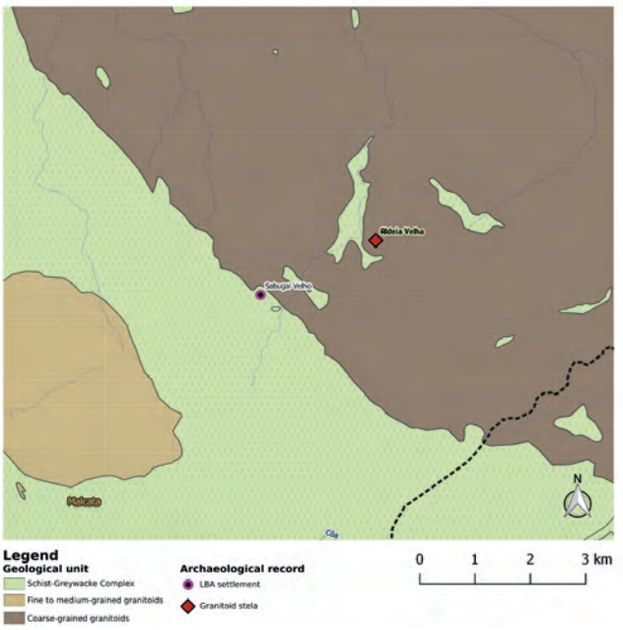

Fig. 5. Simplified geological map around the Aldeia Velha stela findspot, with the surrounding LBA settlements. (Map: M. Osório)

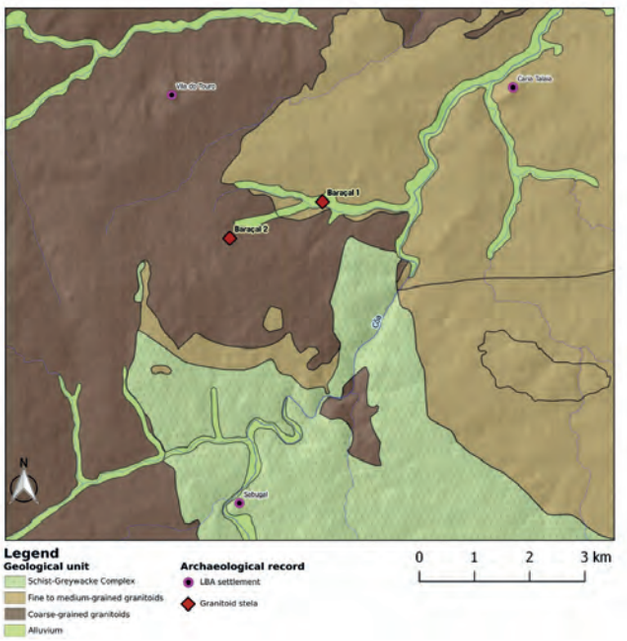

Fig. 6. Simplified geological map around the Baraçal stelae findspots, with the surrounding LBA settlements. (Map: M. Osório)

The stelae from Baraçal were identified 2 km apart, in different geological units. Baraçal 1 was part of a property wall located in the alluvial area of the Moinho Fernandes stream, in an area of medium to fine-grained, non-porphyritic granites, with two micas, likely having been sourced from the northern ridge. Baraçal 2 was repurposed as a building material inside the village, further southwest, in a large area of coarse porphyritic granite, biotitic-muscovitic (Fig. 6). While it was originally equated that the Baraçal stelae could share the same source of raw material (Santos, Vilaça, and Marques 2011, 323), new data shows they present a few differences that point to different quarries (Ferreiro Mählmann *et al.*, in this volume).

Pedra da Atalaia is the only monument engraved in a coarse porphyritic or inequigranular granite, predominant in the region, and colloquially referred to as "granito dente de cavalo" ("horse-tooth granite") due to the large feldspar crystals. These characteristics make it a less suitable material, as it is more prone to erosion and breakage, damaging the engraved motifs.

The stela from Pedra da Atalaia was identified at the summit of a pronounced orographic formation in the landscape, the Ralo mountain range. In this area, there are no fine to medium-grained granites, and the locally available raw material was used. At the foot of the orographic formation, about 2 km to the west, there are presumed areas from which more suitable raw material could come, as well as, about 5 km to the south, some more distant patches and at a higher altitude that would allow for a more efficient transport.

The stela of Telhado, considered to be a "mega-stela" at 2.67 m, the tallest among warrior stelae (Vilaça 2021, 327), corresponds to a medium to coarse-grained granitoid, and was likely sourced within the geological unit in which it was identified.

The stela of San Martín de Trevejo was identified within a fine-grained two-mica granitoid unit, c. 100 m away from an aplite. With the caveat of lacking a petrographic characterization, the morphology of the support suggests it could correspond to an aplite, similarly to the stelae of Baraçal 1, 2, and Aldeia Velha.

The three sedimentary rocks with a low degree of metamorphism (Fóios, Meimão, and Robleda) were all found within the Schist-Greywacke Complex, thus resorting to locally available raw material.

Attending to the distance to the closest granitoid geological unit, Fóios is c. 1 km away, and Meimão and Robleda c. 5-6 km. While for Meimão and Robleda, the large distance could have been an impediment to sourcing a granitoid support, for Fóios other technical or cultural factors might have played a role in the preference for a local raw material. The several lithotypes available in this geological unit, such as psammites, arkoses, sandstones or greywackes, were widely used during the Pre and Proto-history for rock art. With variable hardnesses, some being softer than granitoids, these supports allowed for a good contrast and definition through incision, pecking and abrasion.

5. Stelae, metal ore deposits and settlements

On a meso-scale, a direct association between the location of stelae and mining resources cannot be generally established (Fig. 4), as the areas of higher mineral density do

not overlap with those of stelae. Punctual metal ore deposits can, nonetheless, be found within varying distances from the stelae (Table 2).

These distances suggest that the location of stelae was not directly dictated by the presence of mining resources and are likely a result of the abundance of tin deposits in this territory. The relation between stelae and these resources could rather be established through the paths through which metal would circulate, both as a raw material, ingots, or artefacts.

Contrarily, settlement patterns show a stronger spatial correlation with mining resources. A good example of this are the LBA settlements located in the western edge of the Meseta (Cabeço das Fráguas, Vila do Touro, Serra das Vinhas, Serra Gorda, Castelejo and Sabugal) (Fig. 4) (Osório 2008, 58) in an area with an expressive concentration of tin occurrences. Even in the settlements further from this cluster, several metal ore deposits can be found in their immediate surroundings.

This relation was already hinted by the archaeological findings in each of these sites. During the LBA, the productive capacity of the communities develops, evidenced by the various identified metal artefacts in settlements and hoards (Vilaça 1995, 330–40), as well as by the various archaeological indicators of self-sufficient metallurgical production in the settlements (Vilaça 1998, 351–52), some of them in the vicinity of the findspots of the stelae, such as Vila do Touro (Bottaini *et al.* 2022), Sabugal Velho (Osório 2005, 45), or Argemela (Vilaça *et al.* 2011).

The Beira Interior would, potentially, provide all the necessary resources for bronze production, as both copper and tin are available. Tin would be readily accessible in secondary alluvial deposits (Domergue 1990, 41–42; Merideth 1998, 30–31), and copper in veins exposed on the surface as gossans. Establishing if the local copper and tin resources were sourced for this production is, however, a different challenge.

Some of the mining areas indicated in the records are located near sites with an attested Roman occupation, and some reveal material evidence of the presence of ancient buildings on-site that strongly prove this activity during the Classical Antiquity. Further traces could only be identified in the mines of Quarta-feira (Sortelha), where a bronze palstave was found 12 meters deep (Domergue 1990; Vilaça 1995, 71), as well as another copper or bronze flat axe, found 2 meters deep in the alluvial tin extraction of Cabeço das Quinta das Flores (Vela) (Cardoso 1959; Vilaça and Bottaini 2021, 267). Mining activity would also be likely in the Bronze Age settlement of Caria Talaia (Ruvina), as the 20th century copper mining was based on older traces of exploitation, as well as in Sabugal Velho (Aldeia Velha), where the 20th century open-pit mining of the tin vein (Osório and Marcos 2017, 35) is a few meters from the settlement.

Table 2. Distance between the findspots of the stelae and the closest Cu / Sn deposits. Distances above 10 km were not considered. Aldeia Velha and Baraçal 2 were not considered.

Stela	Min. distance to metal ore deposits
Baraçal 1	5.2 km to Cu; 4.5 km to Sn
Fóios	1.2 km to Sn
Meimão	10 km to Sn
Pedra da Atalaia	6.5 km to Sn
Robleda	8.8 km to Sn
San Martín de Trevejo	4.5 km to Sn
Telhado	5 km to Sn

In this context, the actual exploitation of the mineral wealth of Beira Interior during the transition from the 2nd to the 1st millennium BCE remains an open question. The framework we present should be viewed as merely indicative, as it is not yet possible, at this stage of the research, to determine which resources were accessible with the technology of the time or which were effectively mined.

Even if the location of stelae does not share a direct relation with mining occurrences, the abundance of these resources, particularly tin, was an attractive factor for LBA communities to settle in this territory. Alongside other factors, such as the increasing social complexity, the intensification of contacts, and the exploitation of natural resources, this is likely one of the causes for the emergence of the western Iberian stelae phenomenon in this territory.

Here, these monuments would have been an integral part of the dynamic processes of social and identity production of these communities (Santos, Vilaça, and Marques 2011, 332). Seemingly isolated in the territory, these stelae are deeply related to the LBA landscape and the settlements within it.

The stelae of Baraçal showcase this, as they are almost equidistant from three settlements (Vila do Touro, Caria Talaia, and Sabugal), admitting the Baraçal 1 findspot corresponds to the primary context of the stela (Fig. 7 and 8).

In Vila do Touro and Caria Talaia, occupations in the Bronze Age and LBA are confirmed. Cultural influences from the Meseta and the Lower Guadalquivir are evidenced by the presence of Cogotas I and Carambolo type ceramics (Vilaça *et al.* 2018). Metallurgy is also represented by bronze axes in both sites, and in the case of Vila do Touro,

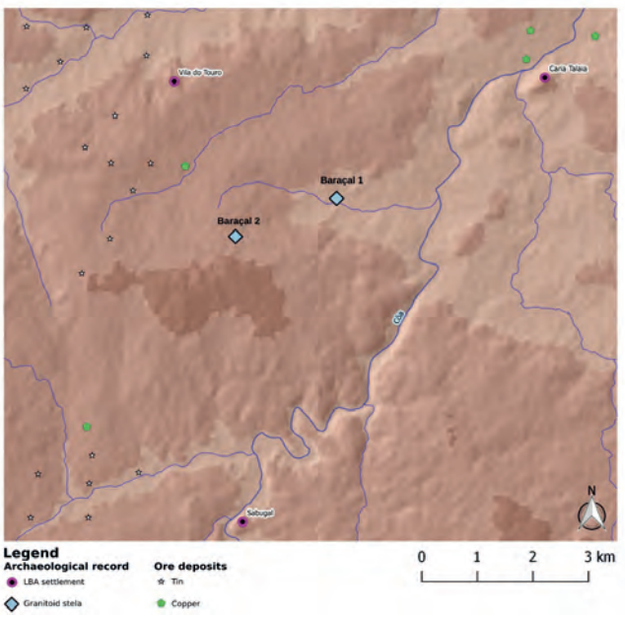

Figure 7. Simplified metallogenic map around the Baraçal stelae findspots, with the surrounding LBA settlements. (Map: M. Osório)

by indicators of metallurgical production, such as a copper ingot (Bottaini *et al.* 2022, 146) and a bivalve mold.

For Aldeia Velha, a potential relation to the Sabugal Velho settlement can be established but cannot be confirmed as the stela was found in a secondary context.

Telhado can also be related with the settlements located in the surrounding mountain ranges of Peroviseu – Meal Redondo (Cabeça Gorda, Quinta da Samaria, Pedra Aguda, Tapada das Argolas) and Gardunha (Covilhã Velha, São Roque, São Brás, and Picoto) (Fig. 9). From the findspot of the stela, all these settlements are visible, and from them, the stela would be visible as well, creating a common and shared spatial reference (Vilaça 2021). In this area, the only excavated settlement is that of Argemela and, even though it does not share an intervisibility relation with the stela, a multicurvilinear fibula was retrieved, identical to the one represented in the stela (Vilaça *et al.* 2011).

Stelae were then an integral part of the LBA landscape, fostering a sense of belonging for these communities and

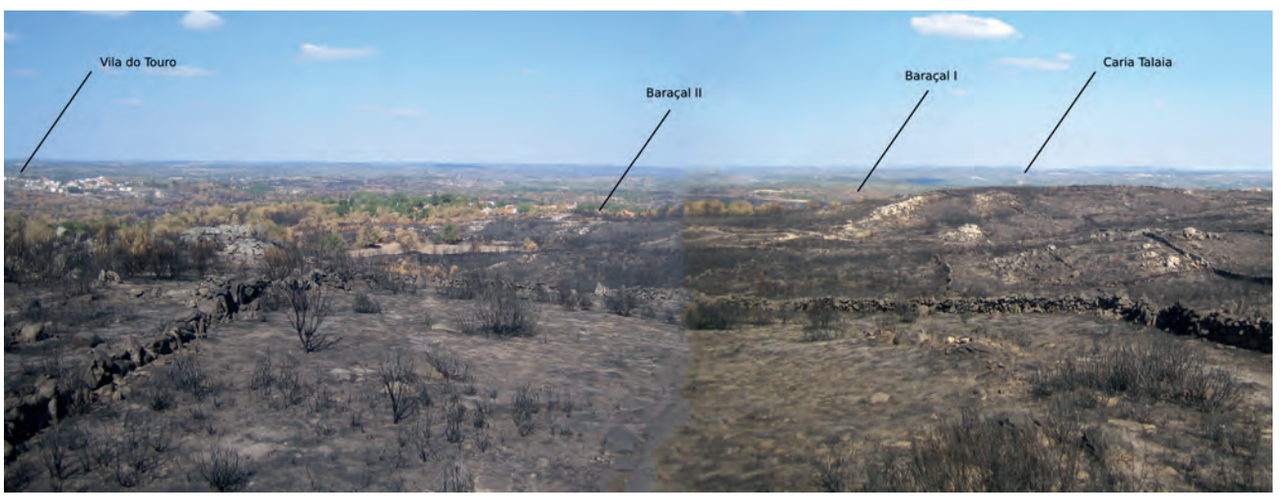

Fig. 8. Composite view of the view from Baraçal geodetic vertex, facing N-NE, with indication of the location of the Baraçal stelae findspots and surrounding LBA settlements. (Photo: M. Osório)

Fig. 9. Panoramic view from Souto do Senhor, facing NE-SE, with indication of the location of the Telhado stela findspot and surrounding LBA settlements. (Photo: J. Bizarro, Fundão Archaeological Museum)

simultaneously appropriating the territory and its resources on their behalf. Based on this analysis, the location of these monuments was not set directly by the existence of mining resources. Instead, it seems stelae are located in converging places, associated with the pathways in which metal, both as a raw material and an artefact, would circulate.

6. Final remarks

The approach undertaken in this study fundamentally problematized the articulation between one of the most expressive testimonies of the LBA - the western Iberian stelae - and the potential sources of their respective raw materials, as well as the critical mining resources of the time, namely gold, copper, and tin (particularly the latter) available in the region. From this cross-examination, using a methodology supported by innovative contributions, it was possible to observe and demonstrate several notions.

Even if the procurement of the supports reaches 5 km in some cases, the stelae are made of raw materials with equivalent characteristics to that of the locally available bedrock or within the same general lithological group. This could suggest that the supports were selected attending to the natural context in which the monuments were implanted as well, seeking to blend them in the chosen places.

A preference to nearby sources of raw material can be observed. In most cases, this still allowed for the selection of a support with suitable technical properties, showing a deep knowledge of the surrounding territory and the natural properties of its resources.

On a macro-scale, the density of stelae found in the western limits of the Central Iberian System overlaps with a significant concentration of tin and an availability of copper ore deposits. However, on a meso to micro-scale, no direction relation can be established between the areas with higher density of mining resources and the location chosen for each stela.

The understanding of the locational strategies of stelae should be sought in the complex interplay between these monuments, the LBA settlements, and the overall territory. Stelae are thus located in specific places in the landscape, integrating a complex network of relevant places, connected by natural corridors and paths, in which people, objects and ideas circulated. Through the spatial and ideological dimensions of stelae, these monuments became a structural building block of the worldview of these communities.

On the other hand, it is important to emphasize that the region analysed in this contribution was limited to the surroundings of the Gata, Malcata, Estrela, and Gardunha mountain ranges, thus excluding the entire territory that extends south of these elevations to the Tagus River, where other warrior stelae, or similar, are also found. There are common issues, but also other challenges, posed by the much scarcer presence of alluvial tin resources.

It will be crucial in the future to extend our analysis to these other cases, also incorporating, as done here, another variable in the equation - the inhabited spaces, which form the foundation of these communities. As we have seen, it is possible to delineate some connections between stelae and settlements, the most explicit being the stelae of Baraçal and of Telhado with their respective surrounding settlements. The reality we perceive to the south, however, appears quite different. Other factors, such as the proximity to water sources, arable and grazing lands, pathways, and funerary monuments, remain equally pertinent and call for holistic analyses and perspectives.

The Beira Interior (approximately the eastern half of the Portuguese territory between the Douro and Tagus rivers) is one of the most studied regions of the Iberian Peninsula during the LBA, but further archaeological research projects, including prospections and excavations, are fundamental to better understand how resources, settlements, stelae, and other LBA testimonies were positioned and related in this territorial framework.

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CHAPTER 9

Exploring the itineraries of Western Iberian stelae: GIS-based provenance analysis between the Tagus River and the Iberian Central System

Pedro Baptista, Ralph Araque Gonzalez and *Rafael Ferreiro Mählmann*

Abstract

This study investigates the transportation and integration of Western Iberian stelae within Late Bronze Age landscapes through GIS-based spatial analyses. Leveraging extensive spatial data from "The Iberian stelae of the Final Bronze Age" interdisciplinary research project, we focus on the movement of stelae from their potential quarries, determined through provenance studies, to their chosen places.

We explore the cultural and territorial significance of these monuments between the Tagus River and the Iberian Central System. The analysis utilizes Least-Cost Analysis, employing Tobler's hiking function to create Least-Cost Surfaces, and includes Least-Cost Paths and Focal Mobility Networks to trace potential routes. Topographic profiles of these paths are examined to determine and compare distance, slope, and walking time. Labour estimates and visibility and accessibility analyses further contextualize the complex and dynamic relationship between paths, quarries, and stelae within the Late Bronze Age landscape.

Our findings shed light on how quarries were procured and how the transportation routes integrated into the existing natural and cultural landscape, offering new insights into the spatial dynamics of Late Bronze Age communities. Lastly, this study underscores the methodological potential of GIS in multi-scalar Landscape Archaeology analyses.

Keywords: Landscape Archaeology; Interdisciplinarity; Least-Cost Analysis; Cultural Landscapes; Late Bronze Age.

Resumo

Este estudo investiga o transporte e integração das estelas ocidentais ibéricas nas paisagens culturais do Bronze Final através de análises espaciais em ambiente SIG. Recorrendo a um extensivo volume de dados espaciais produzidos e registados no âmbito do projeto interdisciplinar "As estelas ibéricas da Idade do Bronze Final: iconografia, tecnologia e a transferência de conhecimento entre o Atlântico e o Mediterrâneo", focamo-nos no movimento das estelas entre as potenciais pedreiras, determinadas através de estudos de proveniência, e os lugares de implantação.

Exploramos o significado cultural destes monumentos entre o Rio Tejo e a Cordilheira Central através de análises de custo ponderado. Foram modeladas superfícies de custo com a aplicação da fórmula de Tobler, através das quais se calcularam caminhos ótimos e modelos de acumulação de fluxo para delinear potenciais percursos. Os respetivos perfis topográficos foram analisados para determinar e comparar distâncias percorridas, declives, e tempo de caminhada. Estimativas de esforço, análises de visibilidade e acessibilidade permitem contextualizar mais aprofundadamente a complexa e dinâmica relação entre caminhos, pedreiras e estelas na paisagem do Bronze Final.

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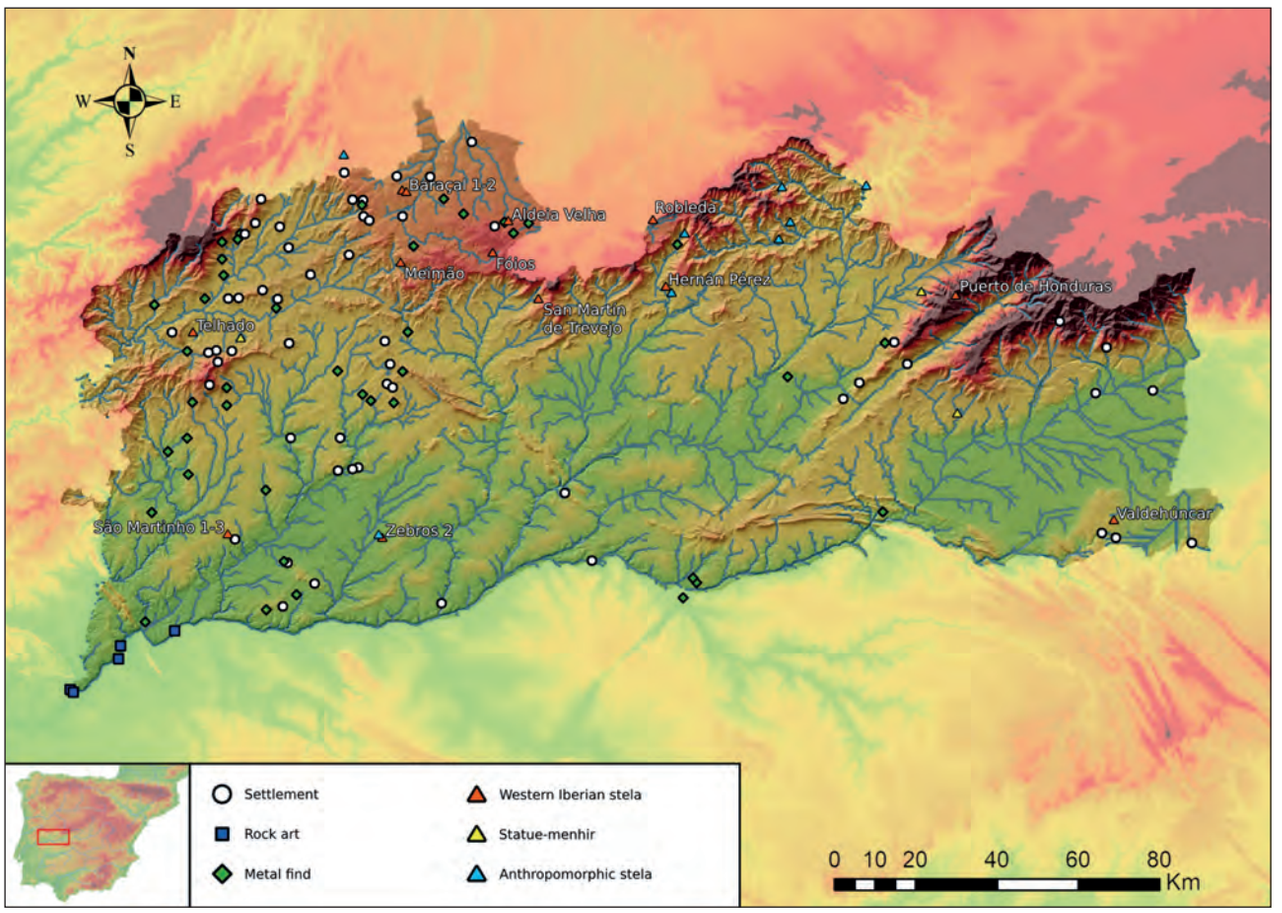


Figure 1. Late Bronze Age archaeological record between the Tagus River and the Iberian Central System. In the inset, location of the study area within the Iberian Peninsula. (Map: Pedro Baptista)

Os nossos resultados elucidam de que forma as fontes de matéria-prima eram procuradas e como o seu transporte era integrado na paisagem natural e cultural existente, contribuindo para a compreensão das dinâmicas espaciais das comunidades do Bronze Final. Por último, este estudo releva o potencial metodológico dos SIG em análises multi-escalares enquadradas na Arqueologia da Paisagem.

Palavras-chave: Arqueologia da Paisagem; Interdisciplinaridade; Análises de Custo Ponderado; Paisagens Culturais; Idade do Bronze Final.

1. Introduction

The large scope and interdisciplinary approach of the research project "The Iberian stelae of the Final Bronze Age: Iconography, Technology and the Transfer of Knowledge between the Atlantic and the Mediterranean" (DFG, project No. 446739573)[1] produced and recorded a vast set of geoarchaeological spatial data. This extensive dataset was then integrated and contextualized into the initially proposed systematic Landscape Archaeology analysis focused on the Portuguese Beira Interior and the Spanish Alta Extremadura. This territory is characterized by a shared territorial and cultural identity at least during the Late Bronze Age (Baptista 2021), and one of its most striking features is the resignification and reappropriation of older rock art forms and funerary monuments (Vilaça 2013, 208–13; Baptista 2021).

The primary objective was to conduct a diachronic and multi-scalar study of the stelae within this expansive and inhabited landscape. This included the precise georeferencing of the findspots of stelae and older rock art monuments, the compilation of Late Bronze Age (LBA, c. 1300-750 BC) and Early Iron Age (EIA, c. 750-500 BC) archaeological occurrences (Fig. 1), as well as the survey and recording of potential rock and metal ore sources in the surrounding territory. Based on this data, a combination of provenance studies, field surveys, and GIS-based spatial analyses was conducted. This approach allowed us to address specific questions regarding Western Iberian stelae, such as the placemaking processes involved or their role in various scales of mobility.

Within this framework, this paper explores an often-overlooked aspect of the itineraries of stelae: the procure-

[1] For more information, see https://www.experimentalarchaeology.uni-freiburg.de/projekt

Figure 2. Examples of places from the analysed itineraries. a) Findspot of the stela of Baraçal 1; b) Findspot of the stela of Meimão; c) Quarry of Barrocal; d) Rata Creek. (Photos a), b), and c): Pedro Baptista; photo d) Ralph Araque Gonzalez).

ment and transportation of the stone support from the quarry to the chosen implantation place (Fig. 2). This is particularly relevant in our study area, as *a)* most of the stelae are located on altitudes, such as mid-slopes, or ridgelines and hilltops (Araque Gonzalez 2018, 192); *b)* it is the area with the largest and most monumental stelae (Celestino Pérez and Salgado Carmona 2011, 426). The difficulty in transporting the stelae in this partly unpassable rocky territory, altiplanos or deep eroded river valleys underscores the importance of these monuments and their chosen places within the mobility network and the socio-cultural landscape of the LBA.

2. A biographical approach to Western Iberian stelae

Western Iberian stelae[2] are among the most iconic archaeological remains dating from the LBA and EIA in the Iberian Peninsula. These standing stones vary in height from 0.50 meters to 2.70 meters, with the larger examples exhibiting para-megalithic qualities (Vilaça 2021, 327).

The stelae primarily depict swords, shields, and spears, forming a basic composition referred to as Format B[3]. When additional objects such as helmets, headdresses, mirrors, fibulae, combs, musical instruments, and chariots are present, the classification is Format B+O. Anthropomorphic figures and animals are also represented on some stelae, occasionally arranged in scenes. These depictions are categorized as Format A.

In the specific study area between the Tagus River and the Iberian Central System, Format B, and B+O stelae are predominantly found. A distinctive characteristic of the stelae in this region is the anthropomorphic shape of the support and their larger-than-life size, which aligns with the tradition of older statue-menhirs. The stelae in this territory reflect the martial iconography of the LBA and serve as important cultural markers within their landscape. The monumental size and intricate iconography of these stelae suggest a substantial social investment, which likely reflects the significant importance of their chosen locations.

[2] This type of rock art monument has various designations in the archaeological literature, including "*Extremeñas*", "Southwestern", "Warrior", and "*Lusitanas*", reflecting the diversity and distinctive characteristics of these numerous specimens. We adopt the term "Western" (Celestino Pérez and Salgado Carmona 2011) grouping both warrior and diadem stelae from the LBA-EIA, although only stelae with warrior iconography are found in our study area (see also Almagro Basch 1966; Celestino Pérez 2001; Harrison 2004; Díaz-Guardamino 2010; Celestino Pérez and Salgado Carmona 2011; Araque Gonzalez 2018, 165–250).

[3] After Díaz-Guardamino (2010, 327–40) typological proposal (see also Celestino Pérez and Salgado Carmona 2011; Araque Gonzalez 2018, 186 for alternative proposals, with previous references.).

Although most stelae lack a stratigraphic context, the findspot can generally be accepted as a primary archaeological context when there are no signs of later repurposing or significant transport. This perspective allows us to understand the place where the stelae were placed or erected as a meaningful spatial context rather than viewing them as isolated finds without any context (see Galán Domingo 1993). Stelae, and prehistoric statuary in general, differ from «fixed» rock art precisely because they do not rely on ideal supports at the chosen location; instead, these can be transported (Galán Domingo 2011, 273). Therefore, the primary consideration would have been the location of the stelae. The spatial dimension of stelae has been acknowledged and linked to natural routes and ancient pathways (e.g. Ruiz-Gálvez Priego and Galán Domingo 1991; Galán Domingo 1993, 35–36, 77–81; Baptista 2019, 37–38; Vilaça and Baptista 2020, 29–30), to multiple strategic resources, such as water sources, farming fields, grazing lands, and metal ore deposits (e.g. Díaz-Guardamino 2010, 368–69, 440–41; Araque Gonzalez 2018, 191–92, 246–47), as well as to settlements (e.g. Vilaça 1995, 402–6; Díaz-Guardamino 2010, 362–63, 401–2; Vilaça 2013, 208) and preexisting monuments (e.g. Díaz-Guardamino 2010, 361–73; Bueno Ramírez, Barroso Bermejo, and Balbín Behrmann 2011, 48–49; Vilaça 2013, 212).

Once the location was determined, the raw material selection would follow. Given that this territory is characterised by having the most monumental specimens (Celestino Pérez and Salgado Carmona 2011, 426), sometimes exceeding two meters in height, it is likely that the sources of the raw material were chosen as close as possible to the intended sites to facilitate the transportation process (see Osório, Baptista, and Vilaça, this volume). In turn, this would require a deep knowledge of the territory and the physical properties of the raw materials (Ferreiro Mählmann *et al.*, this volume).

A theoretical framework that might assist with studying the spatial dynamics of stelae is the concept of the cultural biography of things (Kopytoff 1986). This approach emphasises the social and material entanglement inherent in objects, viewing them not merely as static artefacts but as entities with life histories intertwined with human experiences. The itinerary concept has been proposed for this biographical approach to stelae (Díaz-Guardamino 2015), recognizing the dynamic relationship between people, stones, and places over time, and highlighting how these interactions shape and are shaped by cultural contexts. In this framework, places and the stelae serve as tangible remnants of this itinerary or biography (Díaz-Guardamino 2015, 111–12).

Moving forward, it is crucial to clarify our usage of provenience and provenance. Provenience refers to the findspot of an artefact, whereas provenance considers the broader cultural and historical context that connects artefacts to their origins (Joyce 2013). For this paper, however, we will be using the geological meaning of provenance, specifically referring to the source of the raw material.

Provenance studies have long been integral to the research of megalithic funerary monuments (Carrión Méndez 2008) and are increasingly being applied to the study of rock art monuments, such as stelae (e.g. Merino Martínez *et al.* 2020; Ferreiro Mählmann *et al.* this volume), or "verracos" (e.g. Berrocal Rangel *et al.* 2018; Soto García *et al.* 2023). These aim to identify and trace the geological sources of materials using methods such as petrographic analysis, geochemical fingerprints, and comparative analysis with known reference samples (see Ferreiro Mählmann *et al.*, in this volume). These studies address aspects related to the construction of monuments by defining theoretical resource catchment areas or the main area of provenance (MAP). When geoarchaeological evidence permits, they also identify the specific sources of raw materials (SRM) (Carrión Méndez, García González, and Lozano Rodríguez 2006).

In the early research on stelae, the find notices typically provided a basic description of the raw material and suggested a local provenance without specialized geological evaluation (e.g. Figuerola 1982; Curado 1984; 1986). Recent publications, however, have emphasized a comprehensive approach. Petrological characterization and geochemical analyses are now increasingly common in stelae studies, indicating both local and exogenous sources (Díaz-Guardamino *et al.* 2019; 2020; Merino Martínez *et al.* 2020; Rivera Jiménez *et al.* 2021; Araque Gonzalez *et al.* 2023).

Despite these advancements, the socio-cultural significance of the potential sources of raw materials and the processes of procurement, extraction, and transport, has not been sufficiently explored.

To do so, the provenience of each stela (Table 1) was established based on the information available on the original find notices and through contact with the local populations, as no stratigraphic information is available for any of the monuments. For this analysis, these findspots are considered the primary context to which the stones were transported after quarrying. We acknowledge that these monuments were reutilized and, in some cases, possibly relocated. Nonetheless, as persistent monuments, both the primary and subsequent uses are relevant for the understanding of their role in placemaking processes (Díaz-Guardamino *et al.* 2020, 70). By modelling the itinerary from the source to the final known destination, emphasis is placed on the practical and social aspects of movement and its dynamic nature in the landscape.

Table 1. Summary of details of the Western Iberian stelae in the study area.

Name	Type	*In loco*	Comments on provenience	Find notices
Aldeia Velha (Sabugal, Portugal)	B+O	No	Repurposed in a cellar in a house in Aldeia Velha.	(Vilaça, Osório, and Santos 2011)
Baraçal 1 (Sabugal, Portugal)	B	Yes	Repurposed in the construction of a wall on an agricultural property.	(Curado 1984)
Baraçal 2 (Sabugal, Portugal)	B+O	No	Repurposed as a bench in a house in Baraçal.	(Santos, Vilaça, and Marques 2011)
Fóios (Sabugal, Portugal)	B	Yes	Discovered buried in a property.	(Curado 1986)
Hernán Pérez (Cáceres, Spain)	B (?)	Yes	Discovered during deforestation works for pine planting.	(Almagro Basch 1972)
Meimão (Sabugal, Portugal)	B/B+O (?)	Yes	Discovered during agricultural work.	(Rodrigues 1958)
Puerto de Honduras (Cáceres, Spain)	B+O	Yes	Found overturned, associated with a support system.	(Sanabria Marcos 2011)
Robleda (Salamanca, Spain)	B+O	Yes	Found overturned near a newly repaired forest path.	(Francisco 2019)
San Martín de Trevejo (Cáceres, Spain)	B+O	Yes	Discovered during agricultural work, c. 1 m beneath the surface.	(Figuerola 1982)
São Martinho 1 (76) (Castelo Branco, Portugal)	A	Yes	Discovered on the surface of the northern slope.	(Proença 1903; 1905)
São Martinho 2 (78) (Castelo Branco, Portugal)	A	Yes	Discovered c. 60 cm beneath the surface in an archaeological excavation on the northern slope.	(Proença 1903; 1905)
São Martinho 3 (77) (Castelo Branco, Portugal)	N/A	Yes	No details on the circumstances of the find, aside from being from São Martinho.	(Proença 1910, 5)
Telhado (Fundão, Portugal)	B+O	Yes	Discovered during agricultural work.	(Vilaça 2021)
Valdehúncar (Cáceres, Spain)	B+O (?)	No	Repurposed as a lintel in a house in Valdehúncar.	(Gonzalez Bornay 2022)
Zebros 2 (Idanha-a-Nova, Portugal)	B+O	Yes	Found on the surface during an archaeological field survey.	(Henriques, Chambino, and Caninas 2012)

The SRMs were based on the provenance studies recently conducted by Ferreiro Mählmann *et al.* (in this volume), established through a detailed comparison of petrographic and geochemical data derived from the stelae and from various outcrops identified through extensive field surveys in the surrounding territory. The provenance analysis not only considered the correspondence of lithotypes between the stelae and the field samples but also included matching primary magmatic or sedimentary microstructures, metamorphic recrystallisation microstructures, mineral textures, trace elements, and rare earth elements. Some of these microstructures and element distributions are rare and thus serve as strong indicators or «signatures» of the source material. The location of the SRM also attended to traces of fluvial and aeolian erosion, as the first can be indicative of geological transportation processes, and the latter of the long exposure of the outcrop.

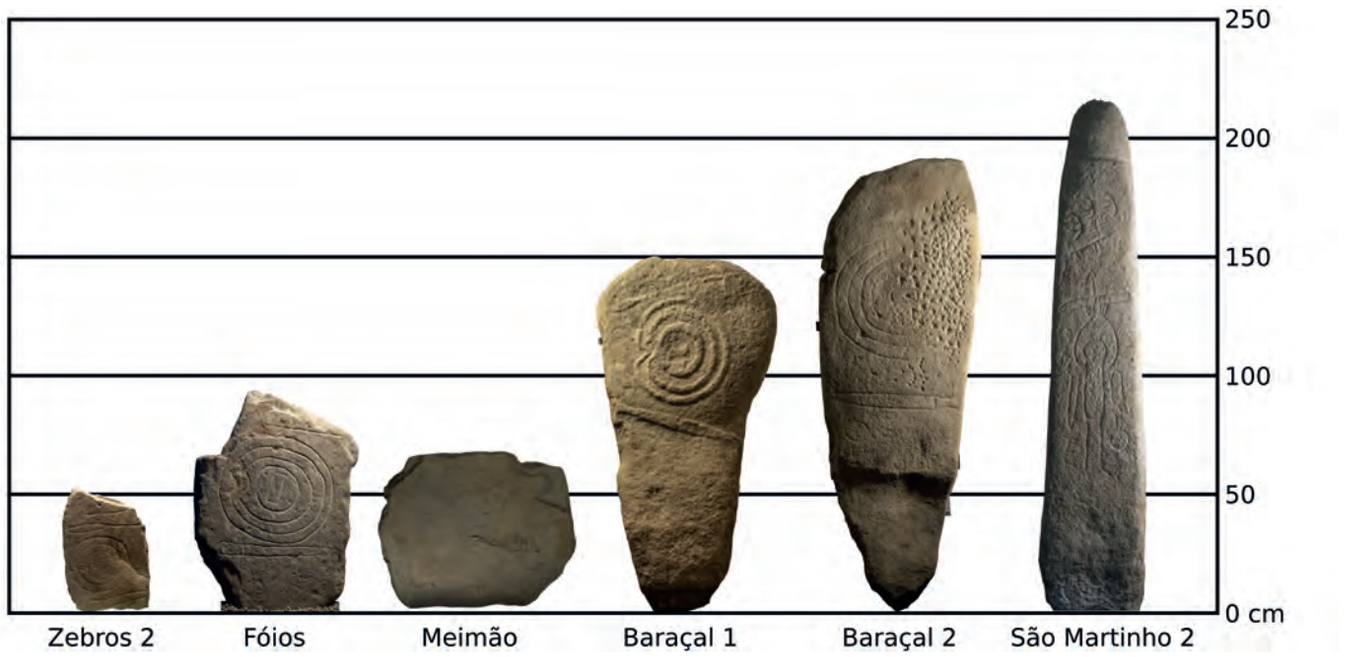


Figure 3. Western Iberian stelae case studies. (Photos: A. Felicísimo, KRAKEN Group)

The provenance of ten rock art monuments has been established by Ferreiro Mählmann *et al.* (in this volume), however, our focus will be on the five warrior stelae, conventionally ascribed to the LBA, whose primary context may plausibly align with the respective findspot (Fig. 3). Moreover, recognizing the archaeological significance of the stelae of Baraçal (see also Osório, Baptista, and Vilaça, in this volume), we conduct an exploratory examination of Baraçal 2 as well, despite its discovery as a repurposed building material in the village of Baraçal. As all these stelae are located in the Portuguese Beira Interior, this area will be the focus of our analysis.

3. Least-Cost Analysis: methodological aspects

Least-Cost Analyses (LCA) provide the appropriate framework to explore transport problems, as they allow us to account for the time-space compression resulting from the specific characteristics of the territory, not relying solely on Euclidian distances. Instead, LCAs are based on Least-Cost Surfaces (LCS), which are raster files where a cost is attributed to each cell. This cost, which can correspond to units of time, caloric consumption, or effort, is calculated using a specific algorithm (for an overview of the application of LCAs in archaeology, see Herzog 2013; 2014; Fábrega-Álvarez 2016).

For this study, we utilised an isotropic[4] adaptation of Tobler's hiking function (Tobler 1993): $w=6exp(-3.5\times abs(s+0.05))$, where w represents walking velocity (km/h), and s represents slope (vertical distance over horizontal distance; can also be obtained by dividing percentage slope by 100). Additionally, an extra cost was proportionally added for crossing waterways. Both slope and waterway variables were extracted from a 10m resolution Digital Elevation Model (DEM), with major anthropogenic features such as dams or motorways edited out. This approach ensures a more accurate representation of past geomorphology. Details on the modelling of a previous version of this LCS can be found in Baptista (2019, 55–63).

Tobler's algorithm was selected as, on one hand, it is a well-established model, widely used in both Human Geography and Archaeology, facilitating the comparison of results with other projects and papers. On the other, the data required to model a specific algorithm for transporting large rocks during the LBA in this territory is simply not available. Although there have been attempts in specific contexts (Hazell and Brodie 2012), these models often result in deterministic outcomes that do not allow for the analysis of the dynamic interplay between human communities and the territory.

Instead, by using a general algorithm and only considering longstanding landscape features like geomorphology and the hydrographic network, we generate a general LCS unaffected by fleeting, unpredictable variables like climate, erosion rates, vegetation cover or presumed individual/community-specific characteristics (see Llobera 2012, 496; Fábrega-Álvarez 2016, 163–64). This approach helps identify paths that communities would likely use in their daily activities, as a result of a fostered and longstanding

[4] Isotropic functions attribute the same cost regardless of the direction of movement being up or downslope. These functions are arguably the most suitable for modelling mobility networks as they account for a path being walked both ways.

relationship between the territory and its inhabitants, generation after generation. It can be argued that these well-trodden paths would be the most suitable for transporting heavy monolithic blocks, as the act of movement is a cumulative process with lasting effects on the landscape (Fábrega-Álvarez and Parcero-Oubiña 2007, 125).

Moreover, one of the most significant differences in modelling human movement, wheeled transport, or the transportation of heavy stone blocks is the determination of the critical slope. This refers to the gradient at which switchbacks and zigzagging become more effective than direct ascents or descents (Llobera and Sluckin 2007). For human movement, steep slopes do not present an absolute barrier and thus the critical slope is relative, depending on various factors. However, wheeled vehicles and the transportation of heavy weights cannot navigate these slopes as easily as walkers. While the critical slope for wheeled vehicles has been established between 12-15% (Herzog 2014, 234), for the transportation of megaliths, a 10% gradient has been proposed based on ethnographic and experimental data (Hazell and Brodie 2012). Since the point of this analysis is to model the preexisting and organic mobility network, a specific critical slope is not integrated into the LCS, but rather considered during the interpretation of the results.

Based on this LCS, we conducted two complementary types of LCA: Least-Cost Paths (LCP) and Focal Mobility Networks (FMN), also known as "*Modelo de Acumulación del Desplazamiento Óptimo*" (MADO) (Fábrega-Álvarez 2006).

LCPs identify the shortest and most effective path between two points based on the LCS. This analysis has been a staple in archaeological studies for reconstructing pathways, although they often lack proper theoretical-methodological support (Herzog 2013, 179). LCPs assume a direct connection between the two input locations, an aspect often hard to infer from archaeological data.

Conversely, FMNs only require a single input location. The flow accumulation to or from it is calculated based on the LCS. This flow can be quantified, defining a network of paths. This network is only constrained by the starting point, without assuming direct connections (Fábrega-Álvarez 2006). Successively, if the FMN connects the origin point to another location, it indicates a territorial predisposition for it, that can be further quantified by calculating the amount of flow channelled. Thus, FMNs create an organic movement network with the most suitable paths for travelling to and from a given feature.

When used together, both LCAs offer significant benefits, as they enable the creation of models to test various theories and hypotheses. For example, if an LCP partially or fully overlaps with the highest flows projected by an FMN, it indicates that the LCP and the SRM are integrated within the organic movement network derived from the stela. Additionally, they allow for inferring and representing aspects of the interplay between communities and their environments, providing valuable archaeological insights.

Furthermore, we calculated the labour estimates for the transport of the raw materials. These calculations contextualize the proposed LCPs and provide a better understanding of the social investment for each specific stela. The minimum number of individuals and cumulative hours for the transportation of each stone from the SRM to the findspot were calculated using the Harris (2019, 159–60) equation: $f = 1000\,(\mu_s w \cos\varepsilon + w \sin\varepsilon) \times g$, where f is the force required, 1000 is the scaling factor to account for metric ton to kilogram conversion, μ_s is the coefficient of friction (0.2), w is the total weight in metric tonnes, ε is the effective slope in degrees, and g (9.807) is the acceleration due to gravity (9.8m/s).. The minimum number of haulers required was calculated for the steepest and average slope by dividing the total force by the force exerted by a single individual (445N). The number of person-hours was determined by dividing each LCP distance by the average speed (0.6m/s) and multiplying it by the average number of individuals required. These values account only for the minimum workforce needed to pull the stones, but additional personnel would be necessary for tasks such as stabilizing the load or providing logistical support.

Harris's equation and the value of each variable are derived from an extensive analysis of experimental and ethnographic data on the transportation of megaliths (Harris 2019, 90–111), some of which with dimensions comparable to those considered in this study. This equation calculates the force required to haul these stones using a system involving a wooden sledge and a timber slipway. Although there is no direct archaeological evidence for the use of this transportation system in LBA Iberia, the technological means would have been available. The primary aim of this analysis is, nonetheless, to determine the relative costs associated with moving different stones over various distances, and not the precise determination of person-hours (see also Shepardson 2006, 141–42).

To calculate these labour estimates, first it is necessary to establish the weight of each stela. The surface area of each stela was derived from front-facing scaled photographs and multiplied by the average thickness to estimate volume. Based on the lithotype of each stela, the volume was multiplied by the average density of the material, resulting in an estimate of mass (Table 2).

To summarise, for each stela with an established potential primary context and provenance, an LCP was cal-

Table 2. Western Iberian stelae physical characteristics.
*Estimated volume of Meimão was increased by 80% to account for the fractured half. Value extrapolated based on shield fracture and area required for representation of spear.

Name	Lithotype	Dimensions (max.)	Est. volume	Avg. density	Est. mass
Baraçal 1 (Sabugal, Portugal)	Two-mica syenogranite (aplite)	155 x 83 x 36 cm (complete)	0.27 m^3	2 700 kg/m^3	0.72 t
Baraçal 2 (Sabugal, Portugal)	Leucocratic muscovite-syenogranite (aplite)	190 x 64 x 24 cm (fractured)	0.23 m^3	2 700 kg/m^3	0.63 t
Fóios (Sabugal, Portugal)	Meta-wacke to sub-arkose	93 x 66 x 9 cm (fractured)	0.04 m^3	2 600 kg/m^3	0.10 t
Meimão* (Sabugal, Portugal)	Quarzitic meta-psammite	69 x 83 x 18 cm (fractured)	0.16 m^3	2 600 kg/m^3	0.40 t
São Martinho 2 (78) (Castelo Branco, Portugal)	Syenogranite (aplite)	207 x 38 x 30 cm (complete)	0.21 m^3	2 700 kg/m^3	0.56 t
Zebros 2 (Idanha-a-Nova, Portugal)	Arkose	50 x 30.5 x 17 cm (fractured)	0.03 m^3	2 600 kg/m^3	0.07 t

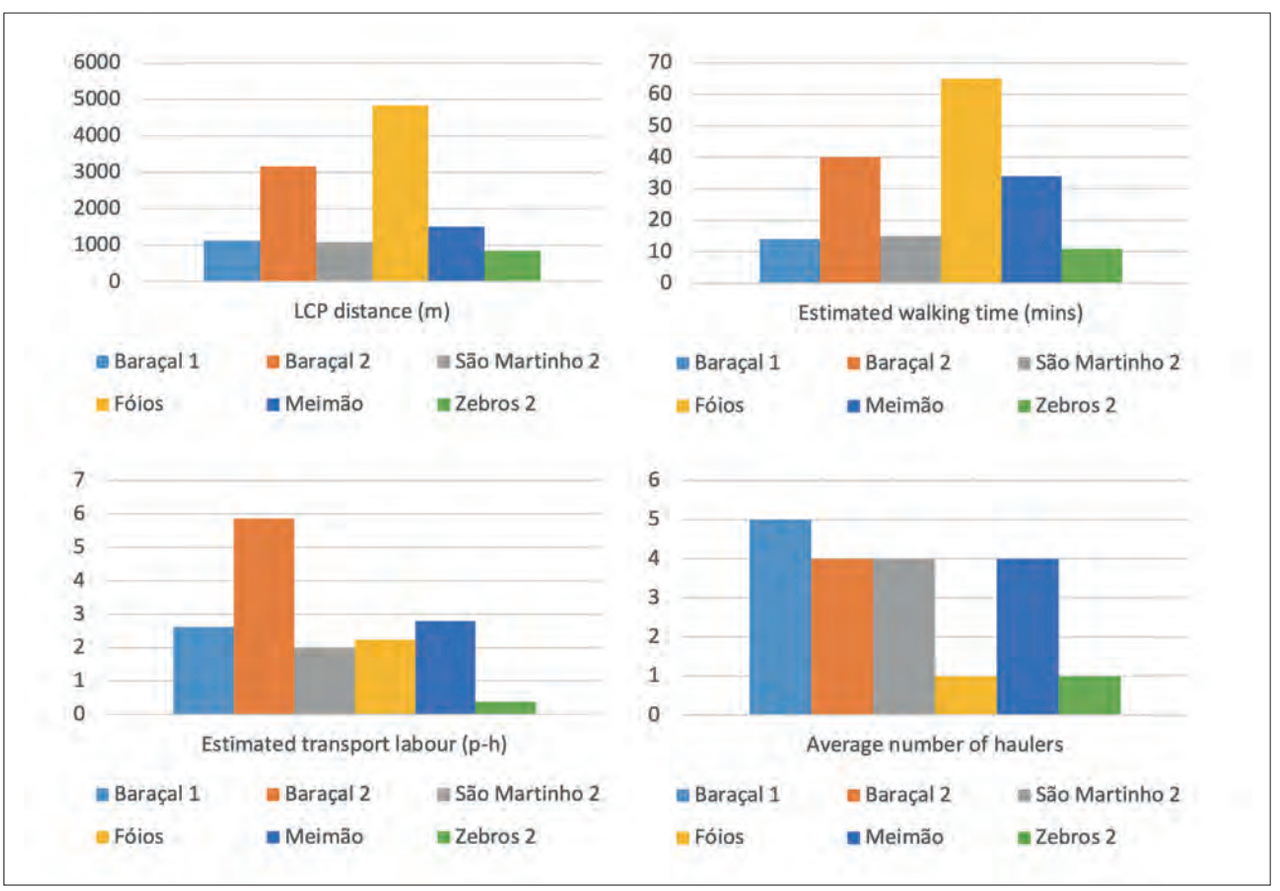
Table 3. Metrics of the LCPs connecting the findspots of stelae to the respective potential SRMs.
*Repurposed in contemporary building; LCP was modelled from the findspot of Baraçal 1.

Name	Lithotype	Potential SRM	LCP distance	LCP avg. slope	LCP max slope	Estimated walking time
Baraçal 1 (Sabugal, Portugal)	Two-mica syenogranite (aplite)	Cabeço dos Cornelhos	1133 m	8.73%-6.82%	26.16%-14.43%	14 minutes
Baraçal 2* (Sabugal, Portugal)	Leucocratic muscovite-syenogranite (aplite)	Pedreira do Barrocal	3162 m	4.70%-7.06%	19.16%-28.05%	40 minutes
Fóios (Sabugal, Portugal)	Meta-wacke to sub-arkose	Rio Côa	4830 m	8.69%-6.28%	23.07%-19.47%	65 minutes
Meimão (Sabugal, Portugal)	Quarzitic meta-psammite	Ribeira de Meimão	1337 m	24.00%-14.44%	54.53%-52.12%	28 minutes
São Martinho 2 (78) (Castelo Branco, Portugal)	Syenogranite (aplite)	Pedreira de Quinteiros	1080 m	10.84%-5.23%	26.06%-23.35%	15 minutes
Zebros 2 (Idanha-a-Nova, Portugal)	Arkose	Ribeira da Rata	845 m	6.07%-1.68%	25.55%-3.45%	11 minutes

Table 4. Western Iberian stelae transport analysis.

Name	Potential SRM	LCP distance	Estimated transport	Avg. no. haulers	Max. no. haulers
Baraçal 1 (Sabugal, Portugal)	Cabeço dos Cornelhos	1133 m	2.62 person-hours	5	8
Baraçal 2* (Sabugal, Portugal)	Pedreira do Barrocal	3162 m	5.86 person-hours	4	7
Fóios (Sabugal, Portugal)	Rio Côa	4830 m	2.24 person-hours	1	1
Meimão (Sabugal, Portugal)	Ribeira de Meimão	1377 m	2.55 person-hours	4	6
São Martinho 2 (78) (Castelo Branco, Portugal)	Pedreira de Quinteiros	1080 m	2 person-hours	4	6
Zebros 2 (Idanha-a-Nova, Portugal)	Ribeira da Rata	845 m	0.39 person-hours	1	1

culated between the findspot of the stela and the respective potential SRM. Additionally, an FMN was calculated from the findspot of the stela. Based on the LCP distance, slope, and mass of each stela, the minimum number of individuals and person-hours required for transportation was estimated (Tables 3 and 4; Graphic 1).



Graphic 1. Comparison of the metrics of the Western Iberian stelae transport analysis.

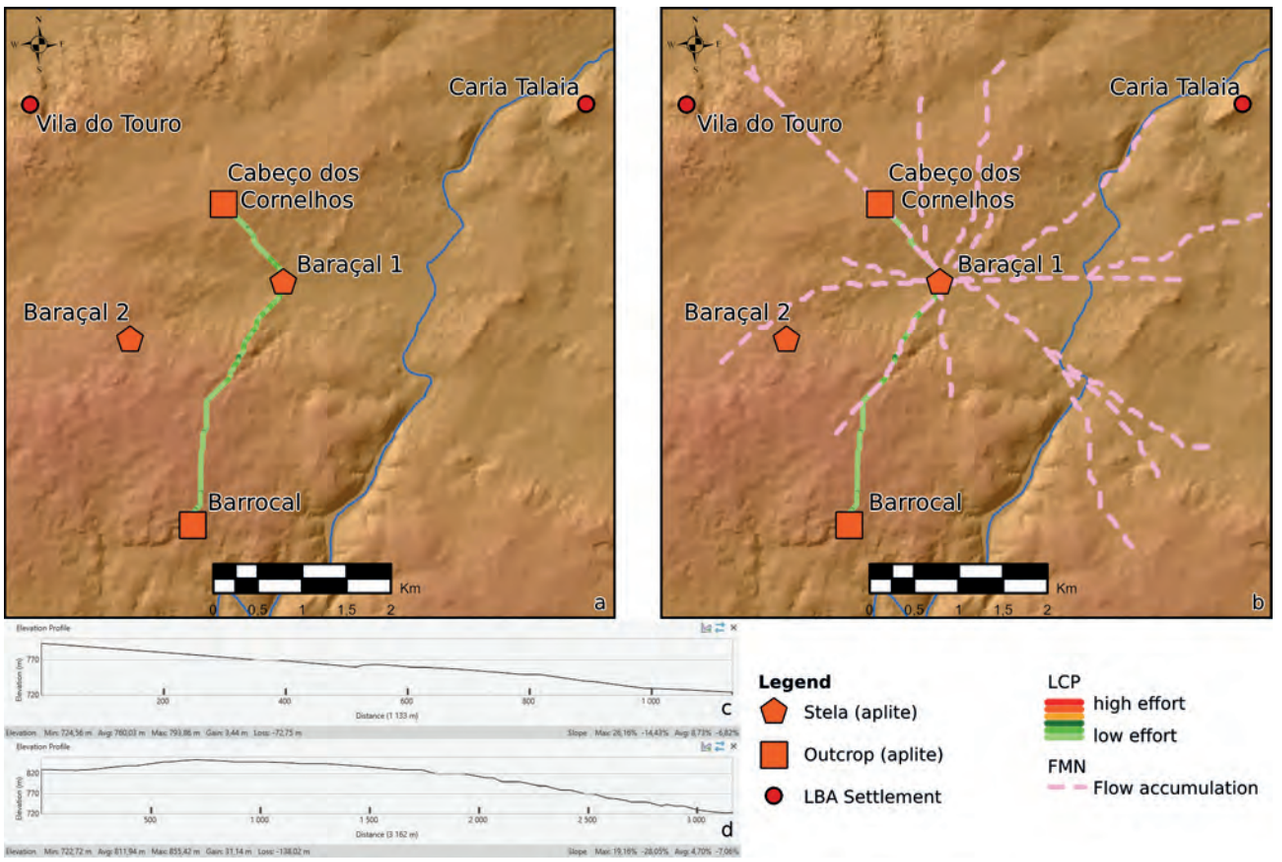


Figure 4. Baraçal 1 / 2 Least-Cost Analysis. a) Least-Cost Paths from Cabeço dos Cornelhos and Barrocal to Baraçal 1 findspot; b) Focal Mobility Network from Baraçal 1 findspot; c) Topographic profile of Cabeço dos Cornelhos – Baraçal 1 LCP; d) Topographic profile of Barrocal – Baraçal 1 LCP. (Map: Pedro Baptista)

4. Least-Cost Analysis: an overview of the results

The six calculated LCPs and FMNs will be discussed in detail in the following section, starting with the granitoid stelae, and followed by the meta-psammite ones. For an overview of effective distance, maximum and average slope, estimated walking time, and transportation person-hours see Tables 3 and 4, Graphic 1, and the topographic profiles of each LCP.

Baraçal 1 (Sabugal) (Curado 1984) (Fig. 3) was identified in a lowland area, approximately 70 meters north of the Moinho Fernandes Creek, east of the village of Baraçal 1. Classified as a rutile-bearing two-mica syenogranite (aplite), the potential SRM for this stela is an outcrop located at the summit of **Cabeço dos Cornelhos**, roughly 1-kilometre northwest of the findspot.

The calculated LCP (Fig. 4a/c) is oriented NW-SE, following a similar course to the present-day dirt road, indicating downslope transportation of the slab. This LCP coincides with the path showing the second-highest flow from the Baraçal 1 FMN (Fig. 4b), continuing towards the LBA settlement of Vila do Touro (Sabugal). This alignment suggests a strong and organic connection between the SRM

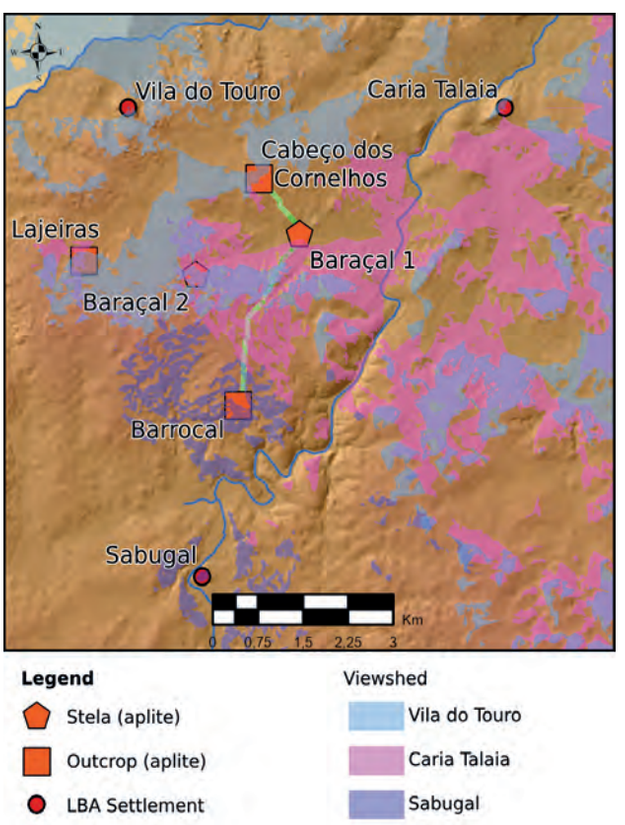


Figure 5. Viewsheds from the LBA settlements of Vila do Touro, Caria Talaia, and Sabugal. (Map: Pedro Baptista)

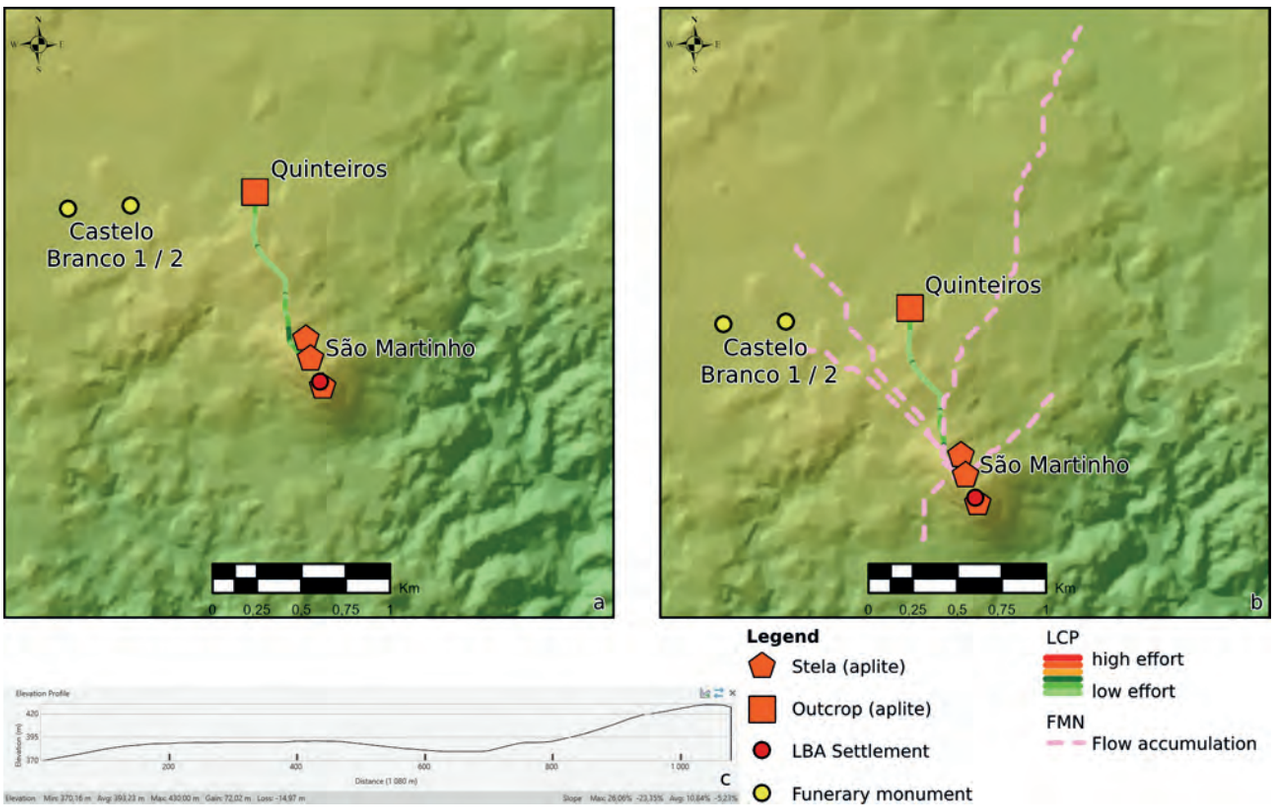


Figure 6. São Martinho 2 Least-Cost Analysis. a) Least-Cost Path from Quinteiros to São Martinho 2 findspot; b) Focal Mobility Network from São Martinho 2 findspot; c) Topographic profile of Quinteiros – São Martinho 2 LCP. (Map: Pedro Baptista)

and the Baraçal 1 findspot, shaped by the geomorphology of the area. Additionally, the FMN path with the highest flow heads east/northeast towards the LBA settlement of Caria Talaia (Sabugal). While the path is not visible from either settlement, Cabeço dos Cornelhos is visible from both Vila do Touro and Caria Talaia (Fig. 5), recognisable by the white colour of the outcropping aplite.

Baraçal 2 (Sabugal) (Santos, Vilaça, and Marques 2011) (Fig. 3) was found during construction work in the old area of the village of Baraçal, where it was being used as a bench in an outdoor patio. Its primary context cannot be confirmed; however, oral information suggests that most building materials were sourced from the Vilares area (Santos, Vilaça, and Marques 2011, 322–23), halfway up the slope between the findspot of Baraçal 1 and the summit of Cabeço dos Cornelhos. It has been proposed that both stelae could have been implanted in the same place (Santos, Vilaça, and Marques 2011, 330–32).

Following this reference, the LCA is conducted exploratorily from the findspot of Baraçal 1. The monument was engraved in a leucocratic muscovite-syenogranite (aplite) and the potential SRM corresponds to an old quarry in **Barrocal**, almost 3 kilometres southwest of the findspot of Baraçal 1.

The calculated LCP (Fig. 4a/d) follows an S-N orientation before joining the SW-NE path derived from the SMN. This partial divergence can be explained by the SMN path following the contour line to avoid the elevation, like the present-day dirt road. The support would have been transported downslope for most of the path, similar to the route from Cabeço dos Cornelhos, but from a significantly more distant source. The first 600 meters of the path establish an intervisibility relation with the LBA settlement of Sabugal up to 3.5 kilometres away (Fig. 5). Subsequent sections maintain visibility with Caria Talaia for 2 kilometres from up to 6 kilometres and with Vila do Touro for 600 metres from up to 3.7 kilometres.

São Martinho 2/78 (Castelo Branco) (Proença 1903; 1905; 1910, 5; Vilaça, Santos, and Marques 2004) (Fig. 3) is one of three rock art monuments identified at the LBA/IA site of São Martinho. This phallic menhir, conventionally dated to the Neo-Chalcolithic and engraved during the LBA, corresponds to a cordierite-bearing two-mica syenogranite (aplite) and was found buried 60 centimetres deep, halfway up the northern slope. The potential SRM was identified in the decommissioned granite quarry of Quinteiros, approximately 1 kilometre northwest, which exploited the outcropping aplite.

The calculated LCP (Fig. 6a/c) is oriented south/southeast. The SRM and the first 500 meters of the path are not visible from São Martinho due to a small ridge, partially avoided by the LCP. There is little overlap between the LCP

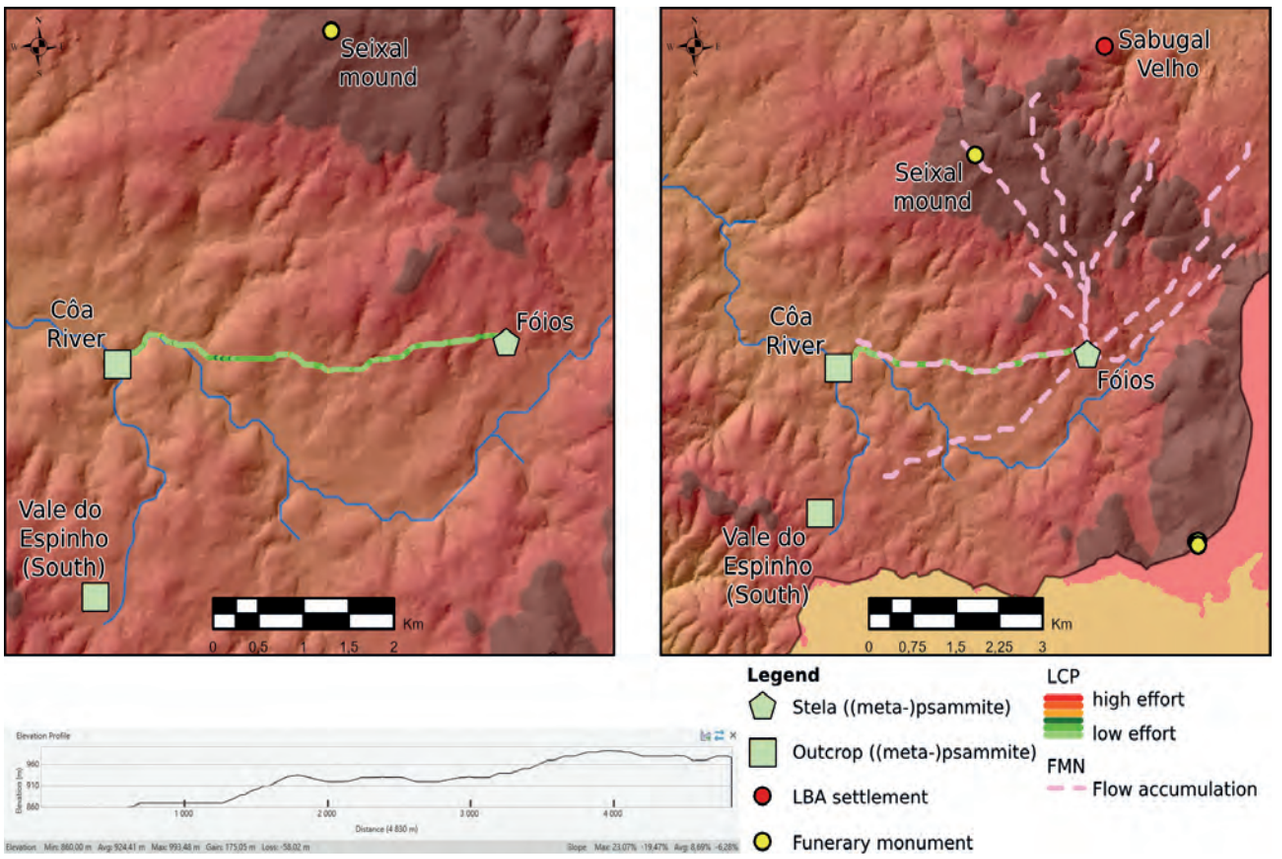


Figure 7. Fóios Least-Cost Analysis. a) Least-Cost Path from Côa River to Fóios findspot; b) Focal Mobility Network from Fóios findspot; c) Topographic profile of Côa River - Fóios LCP. (Map: Pedro Baptista)

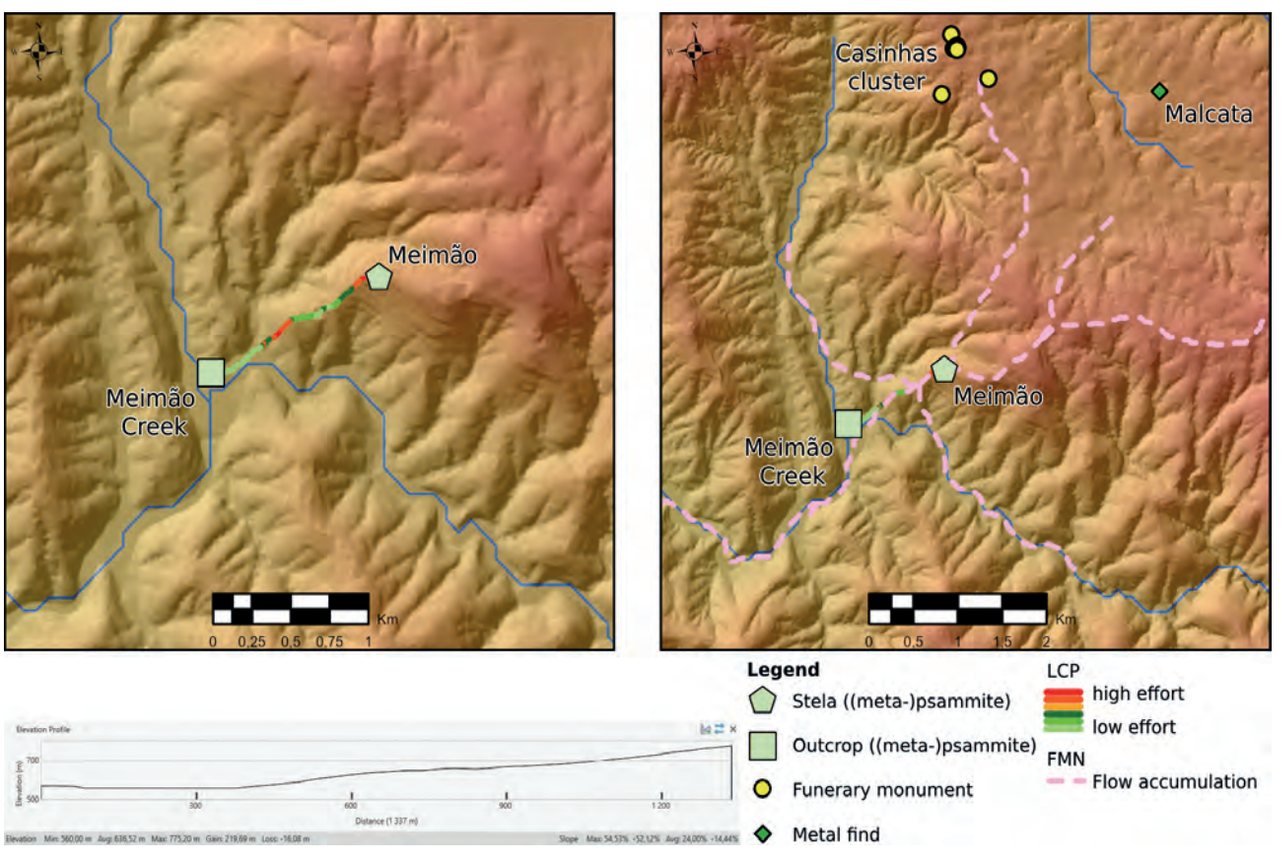


Figure 8. Meimão Least-Cost Analysis. a) Least-Cost Path from Meimão Creek to Meimão findspot; b) Focal Mobility Network from Meimão; c) Topographic profile of Meimão Creek - Meimão LCP. (Map: Pedro Baptista)

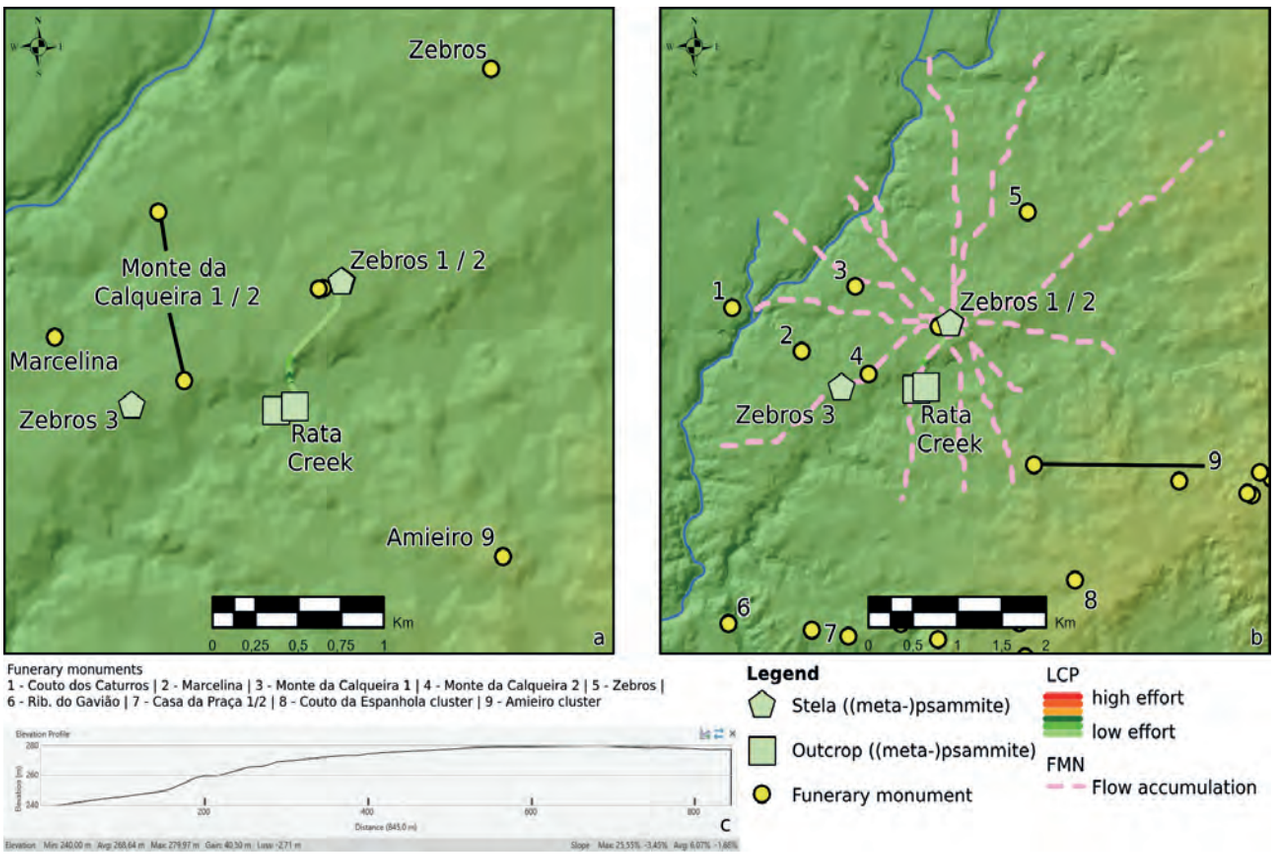


Figure 9. Zebros Least-Cost Analysis. a) Least-Cost Path from Rata Creek to Zebros 2 findspot; b) Focal Mobility Network from Zebros 2 findspot; c) Topographic profile of Rata Creek – Zebros 2 LCP. (Map: Pedro Baptista)

and the FMN paths (Fig. 6b), which only converge at the NW base of the hill, where the most accessible entrance is located. The close distance to São Martinho (1080 meters, approximately 15 minutes walking time) places it within the resource-catchment area of the LBA settlement (Vilaça 2004), even though the SRM could have not been recognised directly from it.

Fóios (Sabugal) (Curado 1986) (Fig. 3) was discovered buried at a shallow depth on a ridgeline overlooking a small tributary of the Côa River, near the village of Fóios. It is a plate of sedimentary rocks from the Gravato formation, with layers corresponding to wacke to quartz arenite, the coarsest one being sub-arkose. The provenance was identified approximately 4.4 kilometres southwest of the findspot, at an exposed outcrop south of the village of Vale do Espinho, close to the Abedoeiros / Meio Creek. For this analysis, the considered SRM is located in the confluence of the **Abedoeiros / Meio Creek** with the **Côa River**, as the stela shows signs of fluvial transportation. A second potential SRM c. 2km east, at the confluence of the Salgueiro Creek with the Côa River, is still under analysis. Interestingly, this is also where the Fóios FMN crosses the Côa River.

This is the longest distance recorded between the potential SRM and the findspot (4830 meters) among the case studies. The LCP (Fig. 7a/c) is eastbound and gradually ascends from the north bank of the Côa River to the ridgeline of Fóios. It integrates mostly with the Fóios FMN (Fig. 7b), except for the first leg of the path. Based on the FMN, the SRM is not located in a possible river crossing area. An interesting aspect of the Fóios FMN is the connection established with the Seixal mound, through the northwestern path.

Meimão (Penamacor) (Rodrigues 1958) (Fig. 3) was unearthed during agricultural work at Cabeça Gorda, near the village of Meimão, halfway up on one of the commanding southwestern foothills of the Malcata mountain range, overlooking the Meimão Creek valley. It corresponds to a quarzitic meta-psammite, probably a quarzitic meta-arenite or a meta-wacke, and the potential SRM is in the **Meimão Creek**[5], approximately 1.3 kilometres southwest and downhill from the findspot.

The Meimão Creek – Meimão LCP (Fig. 8a/c) shows the steepest ascent (219.69 meters) and slope (54.53%)

[5] A new potential SRM (Sample Po66) was identified in very close vicinity to the Meimão findspot, following the same strike of the outcropping feldspar meta-wacke / meta-sub-arkose, suggesting a local provenance for this stela, to be analysed in a future study. The former SRM analysis is nonetheless presented, even though the interpretation of its results should keep this new information in mind.

among the case studies, requiring frequent switchbacks due to the critical slope. Nevertheless, the projected LCP almost completely overlaps with the present-day dirt road, the Meimão FMN (Fig. 8b), integrating into an important mountain pass between the Cova da Beira and the Meseta regions, and establishing an integral intervisibility relation with the Meimão stela findspot (Baptista 2019, 78–80). This natural passageway, outlined by the FMN northbound flow, continues along the ridgeline headed towards the mound cluster of Casinhas (Caninas *et al.* 2009).

Zebros 2 (Idanha-a-Nova) (Henriques, Chambino, and Caninas 2012) (Fig. 3) is one of three rock art monuments identified along the ridge of Zebros and corresponds to a meta-arkose. There are two mounds located on this ridge, one associated with the finding of two of the rock art monuments (Zebros 1 and 2). The potential SRM for this stela is located at the **Rata Creek**, approximately 800 meters southwest, near the contact with a granite dyke.

The Rata Creek - Zebros 2 LCP (Fig. 9a/c) covers the shortest distance (845 meters) among the case studies. The most significant slope gain is between 100 and 400 meters, at which point it overlaps with the FMN southwest flow (Fig. 9b). The remaining FMN paths, directed west-southwest and northwest, head directly towards the mounds of Monte da Calqueira 1 and 2 (near the findspot of Zebros 3).

5. Discussion

A total of 15 Western Iberian stelae have been identified between the Tagus River and the Iberian Central System (Table 1). Although this paper focuses only on the analysis of six of these stelae (Fig. 3), several key aspects that might apply to this territory warrant discussion.

The LCPs established between the potential SRMs and the findspots of the stelae range from 845 meters (Rata Creek - Zebros 2) to 4830 meters (Côa River - Fóios), with an average distance of approximately 1000 meters (Baraçal 1, Meimão, São Martinho 2, and Zebros 2). The highest distances are registered within the meta-psammites (Fóios and Meimão) and with the granitoid stela of Baraçal 2. These values show a clear preference for locally available materials, akin to the stelae of Almadén de La Plata (García Sanjuán *et al.* 2006, 142–43), Mirasiviene (Díaz-Guardamino *et al.* 2019, 73–74), Almargen (Díaz-Guardamino *et al.* 2020, 6115–17), Arroyo Manzanas, La Estrella, Aldeanueva de San Bartolomé, and Aldehuela (Merino Martínez *et al.* 2020, 194), and Capilla I, VIII, IX, and X (Araque Gonzalez *et al.* 2023, 4–7)

It is important to note that the relatively short distances cannot be attributed solely to convenience. Experimental and lithological studies conducted as part of this project (Araque Gonzalez *et al.* in press; Ferreiro Mählmann *et al.*, in this volume) indicate a preference for fine-grained, hard materials, which are well-suited for engraving but also particularly rare. These lithological attributes suggest a deep understanding of the surrounding terrain and the distribution of desired raw materials, as evidenced using quarries located close to the findspots. Some quarries might have been identified due to the distinctive light colour of the aplites, which would be visible from LBA settlements (e.g., Cabeço dos Cornelhos, visible from Vila do Touro and Caria Talaia), or during explorations of the territory and its water resources (e.g., meta-psammites with regular surfaces found near or on rivers and creeks).

Slope values are generally similar across the studied stelae. Meimão is an outlier, with a particularly high average slope (24.00%) and maximum slope (54.53%). As discussed in Section 3, the critical slope integrated into the least-cost surface (LCS) is adjusted for human walking. Additionally, Tobler's formula tends to produce linear paths (Herzog 2014, 232), as seen in most calculated LCPs. Consequently, zigzagging due to critical slopes would have been necessary at certain points during transportation, given the significant elevation differences between the SRMs and the findspots. Except for the Baraçal stelae, the other stelae are in elevated, commanding positions in the landscape.

For three of the stelae, the estimated walking time from the SRM to the findspot is around 10-15 minutes (Baraçal 1, São Martinho, and Zebros 2). The outliers are Meimão, with a walking time of 28 minutes due to the steep rise, and Baraçal 2, with 40 minutes, and Fóios, with 65 minutes, due to sheer distance.

Labour estimates provide crucial context for these results. While it's theoretically possible that a single individual would have been capable to pull two of the meta-psammite stelae (Fóios and Zebros 2), even on the steepest slopes, it's more likely that several people would have been involved in the process. The remaining stelae would have required an average of four to five individuals and six to eight on the steepest slopes. These values are well within the capabilities of LBA communities in the Beira Interior, where settlements typically housed approximately 200 inhabitants, estimated based on settlement area, housing structures, and the productive capacity of the surrounding territory (Vilaça 1995, 252–53). Additional individuals would have nonetheless been necessary for transportation related tasks.

Most stelae require less than three person-hours for transportation, despite the longer distances in the case of Fóios or the steep rise in the case of Meimão. This efficiency is due to the smaller size and weight of the meta-psammite monuments, allowing them to be sourced from further

afield (Araque Gonzalez 2018, 336). Conversely, the larger and heavier granitoid monuments tend to be sourced closer to their destination (see also Ferreiro Mählmann *et al.*, this volume). Both aspects underline the protagonism of the places selected for the stelae.

Baraçal 2 stands out, with an estimated transportation time of 5.86 person-hours. It is important to note that Baraçal 2 calculations assumed that it was located at Baraçal 1 findspot and potentially erected together with it, akin to other known stelae (e.g. São Martinho). These outlier values regarding distance, walking time, and transport estimates suggest that Baraçal 2 was not originally located there. Nevertheless, the labour requirements, while higher, are still within the capabilities of LBA communities.

Interestingly, São Martinho 2 aligns well with the distance, walking time, and labour estimates of other LBA monuments, despite its reuse from an older menhir, likely sourced from its original Neo-Chalcolithic location. This suggests that the menhir was already positioned on the mountain of São Martinho, further supported by its prominence in the Castelo Branco peneplain and its long-standing sacralisation, continuing through the LBA and into Roman and Contemporary periods (Bueno Ramírez *et al.* 2019). This continuity implies that the mountain's sacred status may extend back to the Neo-Chalcolithic, and potentially into the Early and Middle Bronze Age, as evidenced by the monuments of São Martinho 1 and 3.

Within the context of LBA communities inhabiting this territory, the relatively low transportation time of under three person-hours per stela suggests a modest social labour investment, at least concerning stone transport. This stands in sharp contrast to the significant social investment required for the megalithic construction practices prevalent in this region during the 5th and 4th millennia BC (see Caninas 2020). However, the true extent of the social investment becomes evident when considering the entire process, from quarrying and transporting the slabs to dressing and engraving them. Experimental data in the scope of this project estimated approximately 200 hours to prepare the surface of the stela of Baraçal 2 (Araque Gonzalez *et al.* in press). Additionally, tools and logistics also have to be accounted for, as well as the expertise and knowledge of the artisans (Araque Gonzalez 2018, 187–91; Araque Gonzalez *et al.* this volume). This comprehensive approach underscores the significant time and expertise required, only possible through group coordination and collective social networks, as well as a substantial social labour investment, emphasizing the importance of these monuments.

Ethnographic studies and contemporary megalithic traditions further illuminate these practices, revealing the mobilisation of large workforces taking turns in the transportation process (Zena 2021, 9–10). These also shed light on the integration of ritual activities, such as singing, and dancing, and strict procedural regulations, like ensuring the stone did not touch the ground until it reached its final placement (Zena 2021, 9–10). Given the ephemeral nature of these practices, it is unlikely they left material remains, and thus they will largely remain as a hypothesis in the study of Western Iberian stelae.

These processes combined labour and resource mobilisation with ritual practices, fostering a sense of belonging among individuals, communities, and the very land they inhabited (Díaz-Guardamino 2015, 106–12). In this framework, the stelae and quarry sites extend beyond mere functional considerations and are embedded in the LBA landscape.

The cultural and symbolic significance of the places where these monumental stones were sourced reflects their entanglement with the places they embody and the meanings associated with them (e.g. Scarre, García Sanjuán, and Wheatley 2011; Díaz-Guardamino 2015, 112; Ballard 2023, 25–28). The field surveys conducted in these specific SRMs, both before and within the scope of this project, provided limited data to explore this aspect. In the Barrocal quarry, a foreign stone suitable for engraving stelae was identified (see Araque *et al.*, this volume). The other SRMs did not yield archaeological indicators. However, the granitoid SRMs (Cabeço dos Cornelhos, Barrocal, and Quinteiros) were exploited for stone extraction well into the 20th and 21st centuries, potentially erasing earlier traces. The meta-psammitic SRMs (Côa River, Meimão Creek, and Rata Creek) correspond to waterways, their ritual significance evidenced by rock art (Gomes 2010; Henriques *et al.* 2013) or metal depositions (Vilaça and Bottaini 2021) throughout pre and protohistory in this territory, even though specific elements have not been identified in these cases.

It appears that the search for a suitable slab for engraving was the primary priority, which does not detract from the significance of these places but rather redefines their meaning within the landscape fabric. The overlap between most LCPs and the FMNs indicates that these SRMs were well integrated into the active LBA mobility network.

The FMNs provide additional insights that contextualise both the SRMs and the placement of the stelae. The relationship between Baraçal 1 and the settlements of Vila do Touro, Caria Talaia, and Sabugal (see also Osório, Baptista, and Vilaça, in this volume) is increasingly clear, with significant flows from the FMN heading towards each of these settlements, and the path from Vila do Touro passing by Cabeço dos Cornelhos, visible from both Vila do Touro and Caria Talaia, thus serving as a common landscape marker.

Conversely, the FMNs of Fóios, Meimão, and Zebros 2 highlight the relationship between these monuments and funerary landscapes. The mentioned *tumuli* (Seixal, Casinhas cluster, and Zebros cluster) can be attributed to the Bronze Age due to their characteristics – small mounds with a concentration of small, white quartz stones. However, these have never been excavated, and the funerary practices during the LBA in the Beira Interior remain poorly characterized (Vilaça 2013, 208). Although the temporal relations between the stelae and these monuments are difficult to establish, they are integrated into an active mobility network, as is particularly evident in Meimão, located at the westernmost limit of the Malcata mountain range, corresponding to both a border and entry path headed towards the Casinhas cluster. Moreover, our recent surveys in Meimão identified a significant dispersion of quartz blocks, potentially corresponding to destroyed *tumuli* due to intensive reforestation practices.

The entanglement between places and their evolving temporalities is further exemplified in the cases of São Martinho and Zebros (Baptista 2021, 58). At São Martinho, three LBA monuments exhibit a complex history of reuse, consistently anchoring their presence in this significant location, assuming this has been their primary context (Bueno Ramírez *et al.* 2019). Similarly, at Zebros, the spatial coexistence of an anthropomorphic stela fragment, a warrior stela, and multiple mounds along the ridgeline illustrates a layered landscape imbued with diverse symbolic meanings and historical connections (Henriques, Chambino, and Caninas 2012, 36; Vilaça 2013, 212).

6. Final remarks

From the potential source of raw material, identified through geoarchaeological analyses, to the stela's implantation site, this approach explored the dynamics of procurement and transportation of Western Iberian stelae between the Tagus River and the Iberian Central System. The application of LCA within a Landscape Archaeology interpretative framework provided critical insights into the relationship between raw material sources and the landscape within a specific chronological and cultural context. Notably, it was possible to demonstrate that:

1. The potential raw material sources were integrated into the LBA mobility network and would have been recognized either through territorial exploration or directly from the settlements.

2. The social labour investment, consistently under three person-hours, remained constant among the case studies with an established primary context, despite significant differences in distance, slope, size, or weight.

3. Western Iberian stelae played a key role in placemaking and fostering a sense of belonging, intricately intertwining people, places, and the past through the landscape and its mobility network.

GIS-based spatial analyses were instrumental in processing and modelling this extensive set of data and variables. Their results should not be seen as definitive conclusions but rather as exploratory models to simulate and test hypotheses. Ultimately, they serve to aid in developing a deeper understanding of past dynamics. Considering the limited sample size, continued archaeological research and provenance studies in this and other territories with Western Iberian stelae are essential to identify and understand how different communities practised various procurement and transportation strategies for the raw materials employed in building these iconic monuments.

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CHAPTER 10

The Warrior Stelae of the Middle Tagus Valley. The Toledo Specimens

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Abstract

The warrior stelae of the Western part of Toledo province discovered between 1980 and 2014 have greatly expanded their presence in the Middle Tagus area. This corpus has been studied using three approaches. First, a petrological and geochemical analysis provides insight into the provenance and mobility of the stones, and how it can inform regarding the relation of these communities with the final locations. Secondly, an iconographic and technical study allows us to understand how they were made. Finally, a spatial analysis sheds light on the relation between their location and natural fords of the Tagus, which could serve as waypoints in trade networks, thereby construing their presence as a form of exerting control on behalf of those pictured in the stelae.

Keywords: Middle Tagus Valley, Stelae, Landscape, Geology and Technology.

El conjunto de estelas de guerrero del sector occidental de la provincia de Toledo descubiertas entre 1980 y 2014 han supuesto la ampliación del territorio donde aparecen este tipo de estelas en el valle medio del Tajo. El estudio de estos ejemplares que por su ubicación se agrupan en dos conjuntos contempla diferentes perspectivas. Un estudio petrológico y geoquímico a fin de precisar la procedencia de las rocas utilizadas, relacionada a la movilidad de las comunidades que en este ámbito territorial realizan y eligen la ubicación de las estelas como expresión de su presencia y vinculación al territorio. Un análisis y descripción del repertorio iconográfico y la tecnología empleada en la elaboración de los grabados de cada ejemplar que permite una propuesta de reconstrucción del proceso de elaboración de este tipo de estelas. Una valoración de la localización de las dos agrupaciones de estelas en un paisaje que configura el acceso a zonas vadeables en el marco del valle medio del Tajo que asociadas a la explotación de los re-

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cursos del territorio manifiesta el interés por los lugares que se van a convertir en escenario de los circuitos de intercambio que serán controlados por los personajes representados en las estelas.

Palabras clave: Valle medio del Tajo, Estelas, Paisaje, Geología y Tecnología.

1. Introduction

The study of the warrior stelae from the Middle Tagus encounters the same problems that affects all other such monuments in the Western Iberian Peninsula: they are moved from their original position, fractured, are eroded. To top it off, their iconography poses multiple problems. Nonetheless, recent research has explored the potential of new spatial analysis methodologies for elucidating geographical relations with landscapes, routes and resources. In addition, more state-of-the-art techniques, such as applying photography and 3D scanning, provide novel evidence for understanding craftmanship and iconography (see, *inter alia*, Díaz Guardamino *et al.* 2021; Pavón *et al.* 2018; a recent overview in Celestino and Paniego 2021). Recent work continues to adavance our understanding of these pieces (González Cordero *et al.* 2022), the last of which was even found during archaeological fieldwork, thus providing more precise context for the monument (Rivera Jiménez *et al.* 2021[1]).

The study area includes the finds near the ford at Talavera (Barranca del Águila, Herencias I y Arroyo Manzanas o Herencias II) and the natural corridor that crosses La Jara, between the Montes de Toledo and the Sierra de Altamira (Fig.1). They are all relatively recent finds, no earlier than 1980, which have expanded the territory of the stelae further eastward than previously thought. Their discovery and later valuation echo those of other stelae found in other territories, thus reiterating issues with interpretation. The catalogue presented here is ordered according to find and publication date.

2. Catalogue of stelae

1. Las Herencias (Herencias I) (Fig. 2.1). This monument was discovered by chance in a Miocene clay terrace southeast of the village (Chapa y Pereira 2016: 361), from where it was moved to the local school where it remained until it was finally deposited in the Santa Cruz Museum in Toledo in February 1980 (Fernández Miranda 1986; Celestino

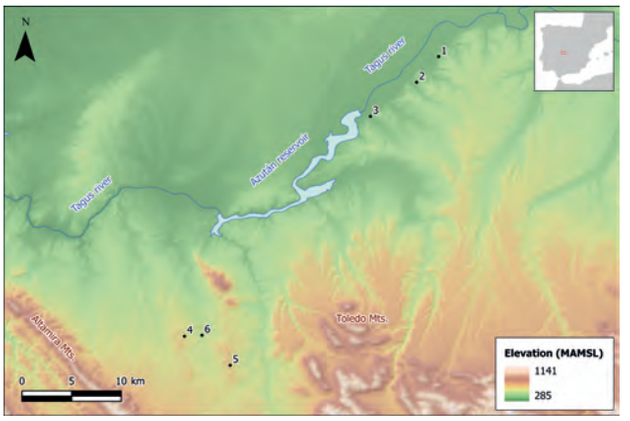

Figure 1. Distribution of warrior steles from the middle Tagus valley (from Cansino 2020) (Media Caja 13x17)

2001, 352-353; Díaz Guardamino 2009, nº 316). It is a rectangular meta-arkose block, with a slightly trapezoidal shape. The petrological composition includes sericite aggregates surrounding quartz crystals, plagioclase, and some rare potassium feldspar. It has an outer reddish color due to weathering, which gets greyer in the inner layers[2].

The rock originated in the area of Valdecañas de Tajo and Puerto de San Vicente (Fig. 3), some 40 km away (Merino Martínez *et al.* 2020). The largest dimensions are 74 cm long, 45.5 cm wide and 15.5 cm thick. The stela can be described with relative ease, despite some fracturing on the left side, which was later polished into shape, whereas the right side is abundantly chipped. The front side was prepared and polished, but later surface flaking has affected some of the motifs. The iconography includes anthropomorphs, a V-shaped notch shield, lance, helmet, fibula and chariot drawn by two quadrupeds.

The Human figure and the shield share position and protagonism. This renders the latter an enormous size in comparison, which the figure attempts to offset with an enlarged torso and head, probably topped with a conical helmet. The nearly-perfect circumference of the head has been chiseled in and then scraped for regularity. The torso is drawn with two convex curves which become concave below the waist, only to become convex again at the knees, which provides the figure with dynamism and volume. The arms from right angles, with the forearms and fingers done with finer, albeit very distinct, grooves.

The great shield is represented from the inside, with a vertical grip and four concentric circles. These circles are extraordinarily geometrical, perhaps indicating the use of a simple compass relying on a central pivot and a string tied to it which perhaps drew or lightly chiseled the outline

[1] The site of Cañaveral de León has provided three stelae found in context: https://huelvamagazine.com/hallan-una-tercera-estela-prehistorica-en-la-zona-de-canaveral-de-leon-que-alberga-un-antiguo-complejo-funerario/

[2] The petrological characterization and provenance study was done using petrographic thin section and geo-chemical analysis. The reference corpus was Andonaegui's lithotype database (1990) with later updates (Villaseca *et al.* 2008; 2014; Merino Martínez *et al.* 2013; 2014).

of each circle. Both the Human and the shield are prominent in the upper part of the stela, drawing the attention of onlookers as a representation of hierarchy would.

The lance is on the right of the Human, with its tip down. It is carved with a fine, deep groove, so straight it probably involved a ruler of some sort. Between the head and the shield there is a diagonal elbow fibula. The pin and bow are deeper grooves forming a symmetrical V, while the head and spring are the result of lighter pecking and polishing, or else chiseled in.

The chariot, represented from above, is in the lower part of the stela, with the pole facing right. It is very deteriorated, especially in the upper part, which corresponds with the left side, where the lines are barely visible. The cockpit, despite the mentioned disturbance, is clearly visible on its right side. There is a double line marking, handles for passengers, and the pole sits across it, stretching out to the end of the horses. The cockpit has concave grooves which were chiseled or pecked, and then smoothed with abrasion. The same symmetry can be inferred from the wheel, which is neatly carved with pecking/chiseling, light scraping, and abrasion. Both the inside and outside have deep round axe marks. A circular shape, right below the lower handle, was done using only a tooth axe. This peculiar shape has been interpreted as a wheel (Fernández Miranda 1986, 467; Celestino 2001, 353), but its misalignment with the chariot, and the uniqueness of the manufacture make alternative explanations are likely.

The horses are very altered and the grooves of the backs and legs are barely discernible due to surface flaking. The backs are convex and different in size. These converging curves, divided by the straight line of the lance, resemble an iconography which is common in these pieces. There are no decorations at the bottom of the stela, suggesting that it was made to be upright, and partially interred.

2. **Arroyo Manzanas (Las Herencias II)** (Fig. 2.2). This stela was found in 1990, during the excavation of the site which is within the municipality of Las Herencias, and taken to the Museum of Santa Cruz in Toledo (Moreno Arrastio 1995; Celestino 2001, 354; Díaz Guardamino 2009, nº 319). It was found, with the decorations facing up, in the middle of a room in Sector IV of the settlement, at the foot of the hill, some 10 m above the Tagus floodplain. Next to it there was a smaller sandstone slab, as well as some scattered cobbles and a tamped clay hearth. This structure was dated to the final occupation phase of the site, during the 3rd-2nd centuries BC (Moreno Arrastio 1995, 276).

The stela is subrectangular, with a pointed upper part and a protrusion in the lower corner. The stone is a metasedimentary rock of the Schist-Greywacke Complex, formed by contact metamorphism. Its surface is irregular,

Figure 2. 1 Stele of Las Herencias (height 74 cm). 2 Stele of Arroyo Manzanas (Las Herencias) (height 109,5 cm). 3 Stele of the Barranca del Águila (Talavera de la Reina) (height 142 cm). 4 Stele of La Aldehuela (La Estrella) (height 140 cm). 5 Stele of Aldeanueva de San Bartolomé (height 98 cm). 6 Stele of La Estrella (height 46 cm). Photographs by Pedro Saura. (Caja Completa 26 x17)

with abundant surface flaking, fissures and porphyroblast inclusions which are common in La Estrella area (Fig. 3), some 45 km distant (Merino Martínez *et al.* 2020). The maximum dimensions are: length 109.5 cm, width 66.5 cm and thickness 14 cm. The left side is violently broken, while the right side is more regular, with two percussion impacts used to remove protrusions. The front is very affected by small but continuous flaking of the outermost layers. Only in the center-left part, where the engravings are, is the surface of the stela more original. The iconography includes: an anthropomorph with a horned helmet, a crude lance to its right, a shield to its left, and a few other figures that are hard to interpret.

The part of the stela which is in better condition is precisely the one with drawings, indicating the main fractures plausibly already existed before the carving took place, constraining the space considerably. The warrior occupies a central position whose prominence is only reinforced with the horned helmet which stretches beyond the full length of the spear. There is a distinct difference in carving quality between the right side and the lackluster left side, where, under the arm, is a shield. The neck is long and lies

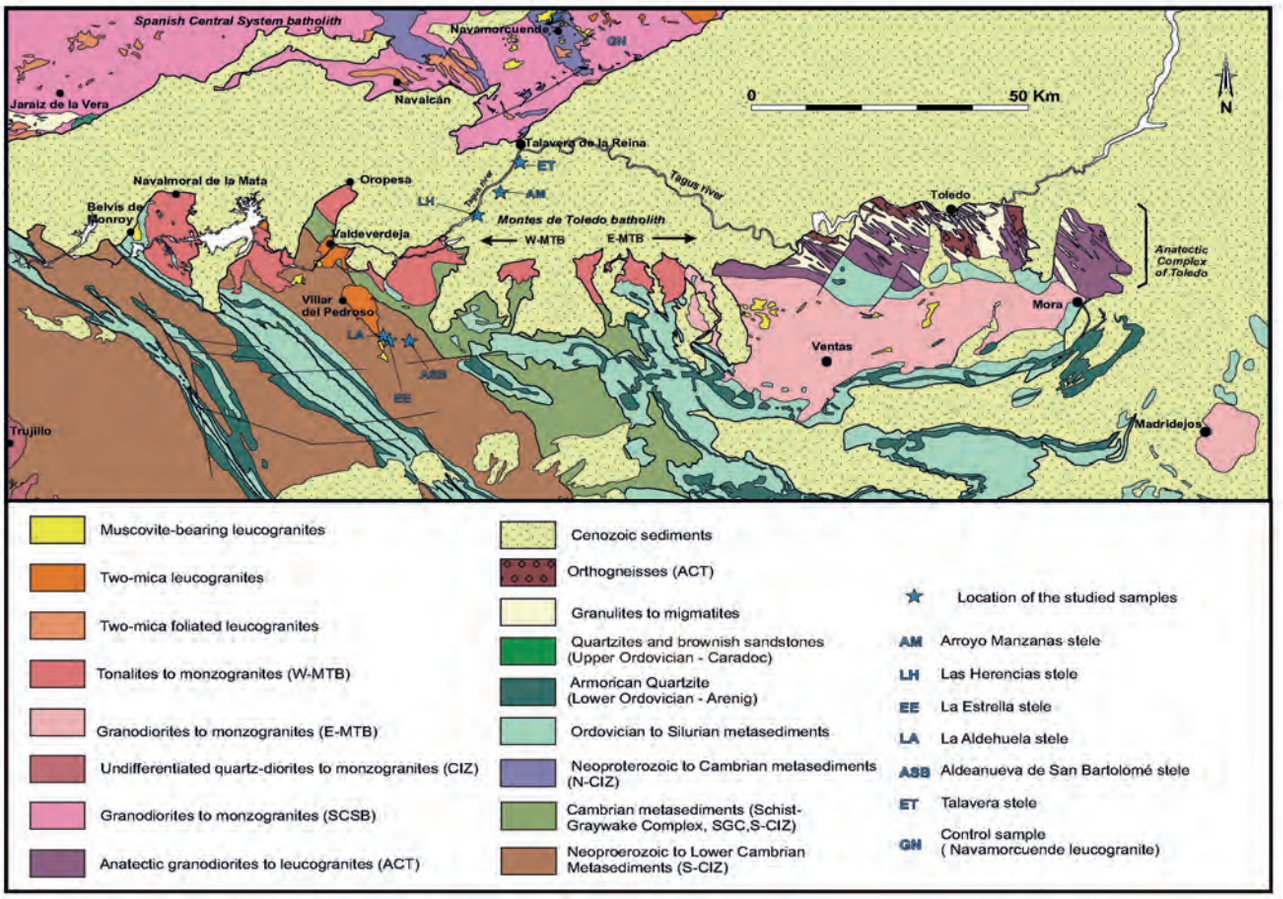

Figure 3. Simplified geological map of the studied area showing the distinct metasedimentary units and the distribution of the different igneous intrusions in the Spanish Central System (SCSB) and the Montes de Toledo (western and eastern segments, W-MTB and E-MTB, respectively) batholiths. CIZ. Central Iberian Zone; ACT, Anatectic complex of Toledo; N-CIZ Northern Central Iberian Zone; SGC, Schist-Greywacke Complex; S-CIZ southern Central Iberian Zone. (Media Caja 13x17).

askew of the axis formed by the torso. The arms are two curves that form an arch, both of them ending in incisions that represent fingers. The body is engraved vertically and with a deep groove, until it reaches the legs, which are two straight lines that end in horizontal feet pointing to the left. Between the torso and the right hand there is a very fine pectiniform motif which may have been engraved at a later time.

The iconography has irregular carving and some misalignments due to the inherent difficulty of working the stone. In addition, the rock chosen, the limited workable space and the simplicity of elements such as the shield, suggest that it may have been the result of an inexperienced artisan, perhaps even an apprentice.

3.Barranca del Águila (Talavera de la Reina) (Fig. 2.3) The stela was found in 1996 when an aggregate supplier truck unloaded sand from the La Viña gravel pit in Barranca del Águila. It is a megalithic menhir with anthropomorphic elements which was then later used for a warrior stela engraving. It was originally deposited in the Ruiz de Luna Museum, but it is currently stored in the Museum of Santa Cruz (Portela y Jiménez 1996; Celestino 2001, 355; Diaz Guardamino 2009, nº 174).It is a quadrangular block with an ovoid tendency. It is made of leucogranite with mid-size grain muscovite and some rare biotite with tourmaline crystal pegmatite clusters (Merino Martínez *et al.* 2019). The petrographic characteristics of this stela are very similar to the peraluminic leucogranite from Navarmorcuende and Belvís de Monroy, which are 27 and 70 km away (Fig. 3). The geochemical signature would point to the closer Navamorcuende leucogranite. It was first brought during the megalithic period, when it was used a statue menhir. Later, in the Later Bronze Age, the upper part would be used for a warrior stela (Portela y Jiménez 1996). Its measurements are 142 cm long, 51 cm high and 33 cm thick. The upper part as well as the left side are both more discolored and dark, probably due to being exposed longer. The greater weathering, however, seems to have affected the engravings more thoroughly, sometimes even erasing them, in the right side towards the top. The iconography includes an anthropomorph bearing a sheathed sword, and a hand with overly large fingers pointing towards a mirror. Under the Human figure there is a shield with a V-shaped notch, and over its head there is a chariot pointing left with two very schematic quadrupeds. There are also some more engravings which are hard to interpret all over the rock.

The block was originally regularized to create a Human-like shape, with much effort done to model the head on the upper part using strong abrasion. The eyes and large nose endow the Stone with personality, at times even seeming somewhat birdlike. The head sits atop a neck and shoulders, and the arms are in relief at the sides. This stone, however, qualifies as a warrior stela because of the carvings in the front of this statue menhir, an example of repurposing.

Given the constraint that this statue imposed on the Bronze Age representations, the artisan clearly opted for prioritizing the Human figure with a sword at its belt, which is central, being flanked by the shield and chariot. The grooves are wide and deep, which indicates that there was engraving, chiseling and abrasion involved. The anthropomorph is unusually dynamic: while his right hand rests on the hilt of the sword, the abnormally large left hand is extended toward a large mirror. The legs are spread wide, with feet pointing in different directions. A helmet rests on the head, albeit only one horn is discernible. The large mirror is closely related to the character, with a subcircular sphere and a handle made of balls. It is possible there was a second mirror which was chiseled in under the right hand, but it was either merely a sketch or has been weathered away.

The shield, despite being below the Human, is quite the protagonist due to its enormous size. It is three concentric circles and a slight notch, which try to fit right up to the right side of the stone, causing some irregularity. The chariot is, in a unique instance for these stelae, above the Human. It is drawn by two horses heading left; the cockpit is divided in two by a vertical line, and it has two handles and two wheels. Conservation of the horses is poor, and yet despite this the grooves are still quite visible.

This stone, which was found by chance, was wholly different from the stones found at the gravel pit. In fact, the leucogranite of this piece has parallels in Navamorcuende, some 24 km of the find site. The statue must have been a significant territorial marker during the megalithic, and was reused in the period in which warrior stelae were common. It is probable that not only the shape of the stone, but also the rarity of the material may have further prompted its reuse as a stela.

4.La Aldehuela (La Estrella) (Aldeanueva de San Bartolomé I) (Fig. 2.4)**.** This stela was used for decades as a bench by the door of a house in El Portalillo (Aldeanueva de San Bartolomé). When the house was knocked down, the stela was revealed and taken to a park area of the village, until it was finally stored by the city hall (Pacheco y Moraleda 1998; Pacheco *et al.* 1998; Celestino 2001, 356; Díaz Guardamino 2009, nº 245). It is a fine-grain Greywacke with small porphyroblast pseudomorphs which indicate a diffuse contact metamorphism. It comes from the Schist-Greywacke Complex rocks found at a distance from the granite (Fig. 3), in La Estrella (Merino Martínez *et al.* 2019). The maximum dimensions are 140 cm long[3], 59.5 cm wide and 14 cm thick. The original work surface was prepared with an abrasion resulting in a soft and homogenous texture. In addition, the use of the stone as a bench has eroded, even erased, some of the motifs in the left side. In recent times some letters and symbols were incised, but their morphology and names clearly indicate a mid-19th Century chronology[4]. The prehistoric iconography includes a Human bearing a horned helmet, a lance, sword and shield, as well as a chariot, a quadruped and an ingot-shaped motif.

The warrior occupies a central position in the stela. It is a linear figure with an extended torso, whose contours are drawn with deep grooves. The legs are made with finer traces, and the two feet are horizontally looking left. The arms, which are somewhat asymmetrical and curved, form an arc which end in three-fingered hands which, like the arms, have been chiseled in. This is different from other stelae, where lines are incised. The head is a deep concave with two curved horns belonging to a presumed helmet which is a bit cocked. This conveys the impression that the head slightly looking up to the right.

The size of the sword, shield and lance are proportional to the Human, and their shape is quite realistic. The shield, unfortunately, has seen how its two concentric circles have been weathered away. The chariot has a rectangular cockpit outlined with two grooves, and an arch in the front. Inside there are side handles, a rudder and the axis joining the two large wheels. The pole and yoke are completely lost to erosion, as this was the main seating area of the bench. Between the lower wheel and handle there is an oblique quadruped, perhaps a horse (or a dog, see Celestino 2001, 356). This animal is inverted, and is drawn very schematically, with the tail and head forming a simple arch. To the left of the warrior's helmet a figure which is slightly rectangular was pecked and then scraped in. It has been known as an ingot, or a fibula (Celestino 2001, 356). In different parts of the stela, especially around the Human and in the lower part, there are various cup marks, some of which appear to form lines.

The figures on this stela are oblique in a way that is rare to find, albeit, to an extent, they are almost parallel to the diagonal edge of the upper part of the stone. Perhaps the askew alignment of the torso prompted the sword, the lance and even the chariot pole to align with it. The Human is very conventional, except for the horns on the helmet,

[3] Maximun length before he cut of 27 cm made in its lower part whit a radial saw to facilitate its public display

[4] Identification made by the Paleography profesor Dr. Carlos Vizuete form the Faculty of Humanities of Toledo.

which are curves that end in tips which are reminiscent of bird heads. The armament, as mentioned above, is of a proportionate size to the body. Even the chariot, which is smaller as usual, is still closer to scale. Notwithstanding, the ingot and fibula still are inordinately large. The stone has numerous cup marks in the rear side (Pacheco *et al.* 1998, 11), but exhibited in its current position they are invisible.

5. Aldeanueva de San Bartolomé (Aldeanueva de San Bartolomé II) (Fig. 2.5). It was found in a place called El Hornillo, east of the village. There are abundant slate cairns, and this stela was one such stone. It was probably subrectangular, but large chunks were chipped off that rendered it a more oval shape. The stela is metagreywacke, a contact metamorphic slate-like stone with fine or very fine grain, with cordierite porphyroblast elements, as well as some andalucite, a very typical petrological composition in La Estrella (Fig. 3) (Merino Martínez *et al.* 2019). The lower part is in the best condition, whereas the central and upper parts are very deteriorated (Pacheco *et al.* 2004-5). On the right side there are long and sinuous vertical grooves which may have been natural shapes deepened by hand. The stone is 98 cm long, 67.5 cm wide and 7.5 cm thick. The original motifs which can still be seen are in the lower third of the obverse. One is a double-lined chariot, a rudder, yoke and reins. Another one is the draft animals, which include a schematic horse, and another beast above, already touching the chipped away part of the stone, which is so deformed it could be a completely different type of horse or an ox. A curve similar to the head of the horse appears in the right side, right next to a crack. In addition, there may be the base of two other possible figures in the altered section (Celestino and Paniego 2021, 84), probably an anthropomorph and a mirror.

The chariot's cockpit, drawn with two boxes of wide U-shaped grooves, has certain traits. On the one hand, the forward corners are rounded. The sides of the inside box slightly extend beyond the outer box in the back end. The inside of the grooves has some side striations indicating that after the groove was carved, it was smoothed and deepened with abrasion. The handles, which tend to be oval in shape, are clearly marked with wide yet shallow grooves. The same fine workmanship was also used in the lower wheel, in contrast with the upper one which is cruder, and appears to be joined to the cockpit with a line. The rudder and the yoke are carved with chisel and pecking, very skillfully used for the rudder but more irregular with the yoke. The reins were carved with narrow V-shaped incised grooves which are very clear, the only figures to use this technique. The way they go around the yoke appear to indicate that they were done after it. There is even a point where there are very fine incisions to mark the reins as they go across the inside of the yoke. The two draft animals are quite different. The lower equine has a curved head, four legs and a tail, with a carefully designed width and careful pecking and some scattered scraping. The upper animal is harder to identify, since it has two ears or horns drawn with various incisions which fail to form a recognizable shape. It is difficult to study this figure since it is at the edge of the original surface, bordering on the altered part of the obverse. Under the chariot there is a curved line which seems more recent. A new equine figure was drawn on the right side, using pecking and scraping.

The last analyses carried out using precision photography have allowed Celestino and Paniego (2021: 84) to identify some images in the worn section of the stela. They include an anthropomorph whose head was a cup mark, on top of a body and an arm bent at right angles. Some of these haphazard motifs may have actually been the result of random markings left by a deliberate erasing of the original markings. There is also a possible bow and arrow, and a horizontal mirror whose reflective surface is scraped in. These new techniques, without a doubt, can contribute to the further detection and analysis of figures.

6.La Estrella (Fig. 2.6). It was fortuitously found at Los Pósitos, a dry farming area near a meander of the Anguilucha creek, right on the limit between La Estrella and Aldeanueva de San Bartolomé. The fracturing of the stone has left us with probably the center of the original stela. It was a stone of fine grain slate whose petrography and geochemical characteristics match those of the contact metamorphism of the Schist-Greywacke Complex (Fig. 3), which is so predominant in the area (Merino Martínez *et al.* 2019). The brown-reddish surface is flaked away in many parts, revealing the underlying greyness. The piece, which is currently trapezoidal, is 46 cm long, 51 cm wide and 10 cm thick. The figures and their distribution are very similar to those found at Aldehuela (number 4). The anthropomorph is clearly seen, bearing a horned helmet, and a sword and shield in his hands. To the right there is a long groove which probably corresponded with another weapon, and perhaps there was a mirror in the upper left side. It is exceptional, despite the dramatic postdepositional life this stone underwent, that the core of the iconography is still intact.

The warrior's head is clearly defined with a cupmark that stems from a long neck which is crossed by a fine incised V-shaped line, which was probably added later. From the shoulders stretch out the curves of the arms; the right arm is significantly better done. The fingers are fine incisions, somewhat varied and irregular, some of which were touched up later. There is evidence in this area of pigmen-

tation or rusting which result in an off-color brownish-red. The torso is clearly defined as it widens towards the bottom. There, a horizontal line which appears to be a baldric since the blade starts below it, marks the beginning of the legs. The legs are drawn with two grooves which are smaller than those of the torso. They seem to be askew of the rest of the body, and end abruptly due to the stone's fracture. The figure has a horned helmet, albeit only the left one can still be seen. The helmet emerges from the head with a very shallow groove which becomes deeper and more regular, though also narrower, towards the top. Some side marks would indicate that this line was chiseled in.

The sword that hangs by the right hand has a hilt which ends in a pommel. The blade is wide and rectangular, until it closes gradually in, into a round tip. A semicircle in the left side breaks this symmetry, and may have been unintended. Another clear groove further to the right may have been a lance, or perhaps a second sword. Both weapons were drawn in detail, first with a chisel which left symmetric and finely-marked edges. Secondly, some scraping was carried out using some round instrument, and finally abrasion. The shield has three circles, and the left side is missing due to the fractures in the stone. The surviving grooves, however, indicate a far less careful artisanship: the grooves are irregular both in width and depth. In addition, some surface weathering has meant sometimes only the bottom of the grooves survived. Some engravings in the upper left corner, appear to indicate a possible horizontal mirror at shoulder height, right by the warrior's left arm. The mirror, which is now only an incomplete semicircle, is affected not only because of the fracturing in the upper part, but also the weathering of the surface on the right. From the base of the mirror emerges a somewhat curvy groove, possible handle, with some parts done without engraving, by alternating scraping and pecking, similar to the shield. In the lower right-hand side corner there is a subtriangular concavity which may be the beginning of a cup mark, or else just an impact. Some other lines can be identified, but they seem to bear witness to post-depositional marks, striations and fractures, left by harder stones in a variety of ways, shapes and forms.

General overview of Toledano stelae

1.**Photographic evidence**. The iconographic analysis and, to a great extent, the technical study, depends on the quality of the images available, which is much harder to come by than would appear. Photography of this type of monument requires the right type of equipment and lighting, that can help overcome the challenge of shedding light correctly on every groove. The photographer in charge, Pedro Saura, had to take the pictures in dark warehouses with cramped

Figure 4. Steles kept in the House of Culture of Aldeanueva de San Bartolome.1 Stele from La Aldehuela (Aldenueva de San Bartolomé I). 2 Stele from El Hornillo (Aldenueva de San Bartolomé II). (Media Caja 13x17).

space, or of pieces that were pinned against a wall, or in rooms where skylights either offered too much light, or too little (Fig. 4).

The color of stones is another aspect that affected documentation, since the different hues reflect light differently, making it difficult to record the minutest of details, including color, as well as traces of artisan activity.

The protocol used was basically the following. A 5,500º K flash which was polarized as needed. There were high-power flashes to blank out surrounding light sources, particularly important if that source was the sun. In addition, there was also a direct light meter. Finally, there was chromatic adjustment to reflect color at 5,500º K.

Locating the lights has been vital to record every detail of the engravings, requiring two-three which could be calibrated to be of different quality (soft, hard, reflected, direct, etc.). The polarization of the lights was also key in order to avoid glares. Nonetheless, in certain instances these glares were helpful in providing more contrast to the engravings. In summary, there was no single system for photographic documentation, rendering it a method of data acquisition like any other in scientific research.

2. Iconographic and technical study

These considerations regarding why certain figures were engraved in stone aim to establish common aspects, without sidelining the uniqueness of each piece. Despite the common patterns, each stone still displays variability in a way that challenges typologies.

First of all, the postdepositional process of the pieces has done more than just change the location. Many of the stelae are fractured to some extent: La Estrella more than any other, though this is also the case for Las Herencias and La Aldehuela. Weathering has also been an important

factor in making the interpretation of figures, in Arroyo Manzanas and more so in Aldeanueva de San Bartolomé, even more difficult. In general, they all have an unworked bottom part which would indicate they were partially buried to be seen standing up, an important factor when understanding the positions of the figures.

All monuments center upon an anthropomorph with, sometimes, a shield that is large enough to also draw attention to it. At Las Herencias and Barranca del Águila it is very large, but in the rest, which have warriors with horned helmets, the size is more to scale, under the left hand, being clearly secondary with respect to the Human. The weaponry, lances and swords, are on the right, as would befit a right-handed warrior.

Since the onlooker's gaze first finds the Human figure, it is later that other elements can be discerned, always frontal, always static. Only when shields are abnormally large does the composition gain some dynamism. In Las Herencias, the warrior on the left is the first stop, but then the shield, which is underscored by the chariot, whose draught animals are heading right. Barranca del Águila leads the attention towards the moving legs and arms, forcing the eye to seek that which the hand is trying to grasp.

It is customary for representations to follow certain formulas, but there is a wide margin for the artisan to imprint his individuality in his work, always within the constraints of his talent and the qualities of the stone. The rocks were first obtained from pieces of different size fine-grain slate or contact-metamorphic rocks. Then they were cut as flat as possible, of to a roughly rectangular or oval shape. A distinctly different one is Barranca del Águila, which reutilized a statue menhir, much thicker and oval than other stelae, but which did not have to be adapted in order to be engraved.

The stones of Las Herencias, La Estrella, La Aldehuela and Aldeanueva de San Bartolomé reveal preparations of the outline of the stela of varying importance, as well as a surface work which involved abrasion and, probably, scraping and chiseling. These processes are still identifiable today through the smoothness of the surface, as well as occasional striations. The surface, however, also reveals that various striations, which can be in groups or isolated, and with different sizes, were the result of post-depositional incidents with crashes with others stones or plows. Only Arroyo Manzanas fails to reveal any evidence of regularization of the shape, albeit it does have some minor preparation of the engraved surface, perhaps indicating that the artisan was somewhat inexperienced (Gutiérrez Sáez 2020, 90). Otherwise, the hands that worked the stones were clearly skilled, both technically and artistically.

Once the block was prepared, the artisan designed the figures to be included by drawing them on with iron oxide or charcoal, or even some fine incision. These sketches not only served to visualize the final result, but also to use as guidelines for the grooves. The torso and arms of the warrior in Arroyo Manzanas, or the legs and helmet of the warrior in Las Herencias (Fig. 5) are probably distinct examples of this. On the other hand, some fine guidelines may have been abandoned on the rudder or lower wheel of the Las Herencias chariot (Fig. 6). The original design probably included all the elements, but perhaps the difficulty of the stone, or else a substitution for other elements, altered the original design.

The engravings themselves use various techniques. Incision is seldom employed. Most commonly, the fingers of the warriors of Arroyo Manzanas, Las Herencias, La Estrella and La Aldehuela. Other occasions are the toes of the left foot in Arroyo Manzanas, the lance and part of the fibula in Las Herencias, or the reins of the chariot in Aldeanueva de San Bartolomé. Other lines are drawn using indirect percussion: pecking or chiseling; later weathering makes it very difficult to distinguish between these two. Sometimes, these lines are accompanied with scraping of some grooves, and in wider surfaces such as heads (Las Herencias, La Estrella), or the ingot of La Aldehuela. Cup marks abraded using manual drilling are quite common, notably the warrior heads of Arroyo Manzanas and La Aldehuela. Reading these stelae is complicated. We have possible symbols, such as the pectiniform next to the warrior of Arroyo Manzanas, or the angular figure in Las Herencias. Some figures may have been erased. There are also retractions, such as the possible mirror which is invisible to the naked eye in Barranca del Águila, may have been partially erased. As for later additions, the drawings of the warrior of Las Herencias may have been refreshed at a later date, in contrast with the other grooves on the same rock.

We do not know what tools were used, although some minute evidence of 3.5-5 mm chisels may have left their marks. Some of the tools probably involved galvanized iron (Araque Gonzalez *et al.* 2023), and stone tools were probably also used, both carved and polished. But we believe that it was mostly chisels and perhaps even a bronze stylus, as some experimentation led us to believe (Gutiérrez Sáez *et al.* 2020). Other supporting elements included rulers and compasses, as well as perishable jigs which would allow the perfection of some straight and curved segments, as well as lines that combine both shapes (Gutiérrez Sáez *et al.* 2020). There is no plausible proposal to explain how these representation models became so widespread in the Iberian Southwest. The metallic tools necessary were hard to come by, and yet the designs are very similar despite the long distance between them, which prompts the hypothesis that there were traveling artisans. Nevertheless, the long duration of this practice and the diversity of rock that it

Figure 5. Guide grooves of the feet of the warrior of Las Herencias (Media Columna 13 x 8,2).

Figure 6. Abandoned guide groove, Las Herencias cart. (Media Columna 13 x 8,2).

used may have also warranted for local artisans who knew the designs and how each type of stone was best worked. It is possible that the models were also transmitted in wood or animal skins. Finally, there is the issue of whether they were representations based on real objects, or just iconographic conventions.

The postdepositional process of these stelae has meant that they were all significantly weathered, and in different states of fracturing. No intentional destruction has been evidenced in the granite stelae of Barranca del Águila or Arroyo Manzanas, whose poor conditions appear to be the result of lack of prior preparation of the rock. Other pieces reveal an array of conservation issues. At Las Herencias, the chipping that took place on the sides were actually done front to back and back to front. Nonetheless, the iconography save for the tip of the lance, was almost completely spared, demonstrating care when altering the rock. Aldeanueva de San Bartolomé, unfortunately, did not benefit from this care. The stone was chipped away and hammered all over, nearly destroying all the figures, except for a horse head and the chariot. La Aldehuela and La Estrella have suffered destruction more recently. The former was used as a bench since the 19th century, and it was therefore chipped into shape, and some of the figures were worn down by use. The latter was broken all around, with some chippings being old, as in the top left-hand corner, while the other fractures are recent, most probably accidental, given the lack of sheen.

3. The Toledano stelae in the middle Tagus valley

The relation between the 39 warrior stelae of this territory with their landscape has been analyzed geographically (Celestino and Salgado 2011; Celestino *et al.* 2012; García San Juan *et al.* 2012; 2017; Costa 2013; Pavón *et al.* 2018; Díaz-Guardamino *et al.* 2019; 2022; Cansino 2020) (Fig. 7). The study reveals diversity, but three patterns emerge. The first pattern has to do with farming. On the one hand, there is a preference for extensive farming areas, in contrast with more mountainous areas were stelae that lack anthropomorphs are more common. This alternation has been considered possible evidence of transtermitance (Antón 2003, 211), inspired by the ideas of Galán (1993, 78) and Cansino (2020, 11). In this custom, the lower and dryer lands were good for farming and husbandry in the cooler months, and the upper and wetter reaches were perfect for the summer.

A second pattern emerges regarding mobility. On the southern side of the river, there are stelae in places close to natural drove ways and areas with transitability. In a way, they mark nodes in a network of movement which may well have been transhumant, a practice which has historically been very important in this area (Flores 2003),

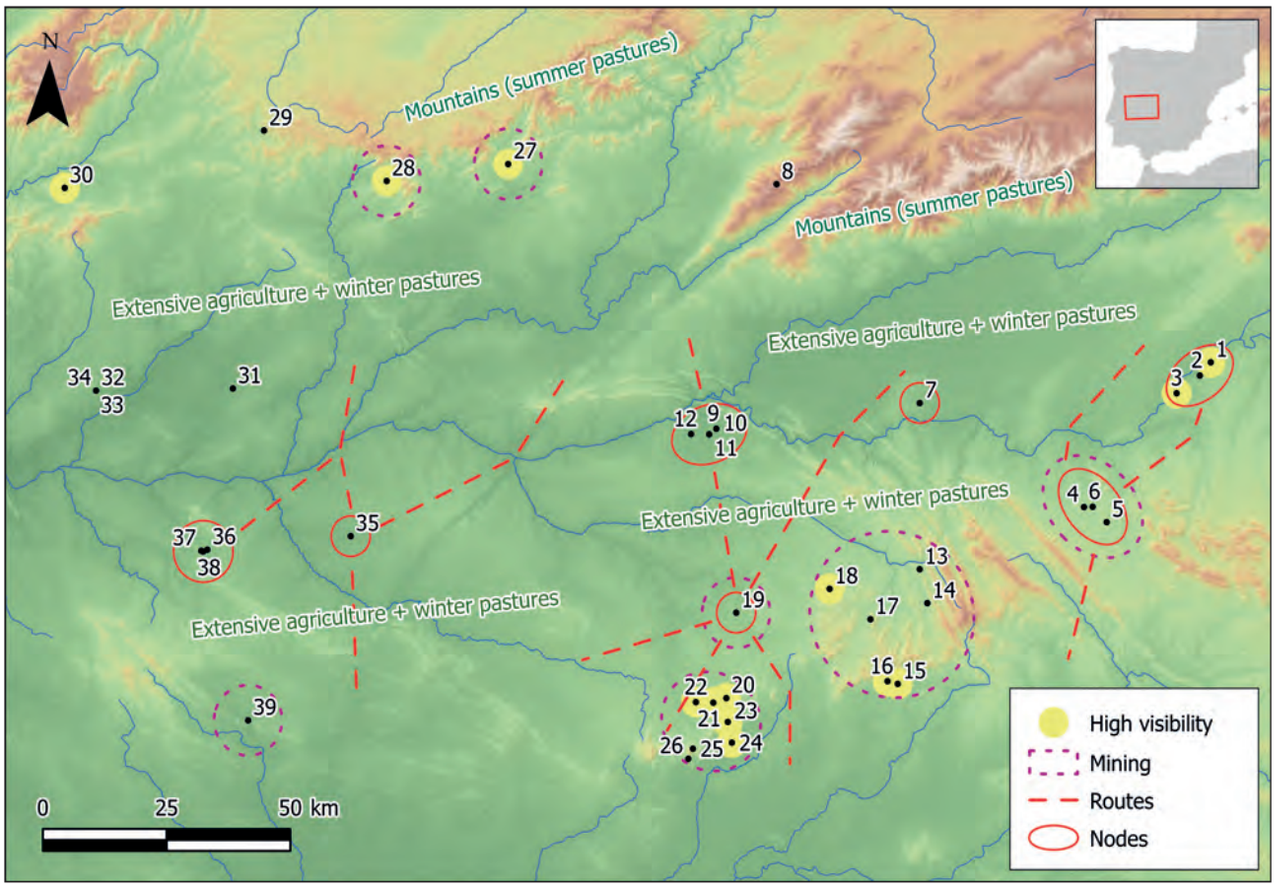

Figure 7. Map that summarizes the conclusions of the geographical analysis. (Media Caja 13x17).

or else simply for the long-distance trade networks of Mediterreanean/Atlantic prestige goods (Galán 1993; Celestino *et al.* 2012; Díaz-Guardamino 2015; Merino *et al.* 2020). The three stelae near Talavera (Las Herencias, Arroyo Manzanas and Barranca del Águila) are on hills overlooking the Tagus valley, near to the ford at which the Roman city would grow (Díaz-Guardamino 2015, 117-120; Moreno 1995). The three near Aldeanueva de San Bartolomé, are also along the corridor that connected the Montes de Toledo to the south with the Sierra de Altamira in the north. This corridor, still a drove way today, crosses the Tagus in the ford of Azután (Moraleda and Pacheco 1998, 14; Pacheco *et al.* 1999, 10; Pacheco *et al.* 2004-2005, 28; Chapa and Pereira 2016, 365).

Finally, the final pattern can be found when understanding the spatial relation with mineral resources. Many stelae are near mountains, such as the Montes de Toledo, the mountains in central Extremadura and the Central System (Fig.7). These include the last three mentioned in the previous pattern, La Aldehuela, La Estrella and Aldeanueva de San Bartolomé. This proximity could be indicative of some mining activity, always in relation with the trade network these stelae also associate with (Galán 1993, 24-25; Celestino 2001, 59-64; Mederos 2012; Díaz-Guardamino 2022, 340).

4. Conclusion

The warrior stelae have been considered a fundamental expression of the 'process of appropriation of the territory by chiefdoms' (Pavón *et al.* 2018, 57), hence bearing witness to the territorialization of communities in the Late Bronze-Early Iron Age period. There are no contemporary habitats found associated with these stones. Nevertheless, it appears that they are markers associated with a growing importance of fords and routes. Its existence indicates that groups of people who lived in this area at the end of the Bronze Age began to mark their presence on the landscape in and around the checkpoints of the long-distance trade routes that connected the Tagus valley with the Northern Meseta.

These places of regional mobility would become nodes in an increasingly extensive trade network. The leaders of this strategy would be the class depicted in the stelae, beneficiaries of the increased trade and protagonists of the reorganization of the territory to bolster husbandry, mining and agriculture. The intensifying contact with the Phoenician cultural influence of the coast, as well as the economic and demographic growth, prompted greater control over the landscape, thereby foregoing nomadism in favor of stable settlement. This territorialization is part of the new

economic framework, that integrates the relationships and exchange circuits established between the Phoenician colonial complex and the peninsular native communities with significant manifestations in the archaeological record of this territory (Pereira Sieso 2008).

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CHAPTER 11

*What is the riddle of steel?** Landscape, Warriors, and Memory in the Alentejo's Final Bronze Age

Rui Mataloto and *Bianca Viseu*

Between the time when the oceans drank Atlantis, and the rise of the sons of Aryas, there was an age undreamed of.

Akiro, the Wizard, opening. **Conan, The Barbarian**, 1982.

Abstract

The Final Bronze Age in the Alentejo region is marked by the occupation of mountaintops where extensive sites, typically surrounded by a large embankment, stand prominently in the landscape. These large hilltop agglomerations, which functioned as solidarity networks, provided commanding visibility of the area and were intentionally constructed to be seen by others. Alongside these networks, another network of small-and medium-sized sites occupied the lower hills overlooking the plains, with some located in the lowlands themselves.

The productive systems of the Final Bronze Age in the region suggest the presence of dispersed family units, thus leading to the dissemination of shared agricultural, metallurgical, and textile production methods throughout the previously defined settlement networks. In the Alentejo, the Bronze Age is characterized by a reduced presence of mythical and sacred graphic expressions, in contrast to the vast diversity found in earlier periods. However, there are numerous indications of a strong sense of identity rooted in communities' Lieux de Mémoire, as suggested by the reuse of megalithic monuments, both funerary and menhiric. This process of identity formation took place primarily in the Early Bronze Age. Over time, representations of the warrior's panoply and associated iconography depicted on stone stelae has shifted our understanding of this period – a period previously believed to lack iconographic representations. During the Alentejo's Bronze Age, the creation of memory was integral to the aggregation of communities. These communities, perhaps driven by a feeling of insecurity, gathered at the highest points in the landscape. This movement, which took place primarily in the second half of the second millennium BC, coincides with the celebration of a mythical cosmology affiliated with heroic iconography as represented on stone stelae. To a large extent, this rich warrior iconography appears to have stemmed from a broader trans-European concern with warriorship.

* Taken from *Conan the Barbarian*" (1982) – of John Milius and starring Arnold Schwarzenegger and James Earl Jones. This production was largely filmed in Spain (https://www.youtube.com/watch?v=HlP_i6L6Xxg&t=18s; https://www.rtve.es/television/20230704/conan-barbaro-arnold-schwarzenegger-rodada-espana-jorge-sanz/2450469.shtml), which may not be insignificant when we notice obvious similarities between Conan's warrior imagery and those found on the stelae of the Iberian southwest, where horned helmets, swords, and warrior paraphernalia in general stand out. On the other hand, it seems clear that the true mythology surrounding the post-palatial Dark Ages in the Eastern Mediterranean, developed from the end of the 19th century BC, and following Schliemann's findings in Troy, did not fail to influence Robert E. Howard, creator of the character Conan, in the early 1930s. This text aims to pay homage to a film that serves as a metaphor for the context of the creation and installation of stelae of the Iberian southwest at the end of the Bronze Age. In many of them, we can imagine the adventures of sword and sorcery created by Robert E. Howard, and recreated by J. Milius (see: https://therumpus.net/2009/06/30/conan-the-barbarian-an-appreciation-seriously/)

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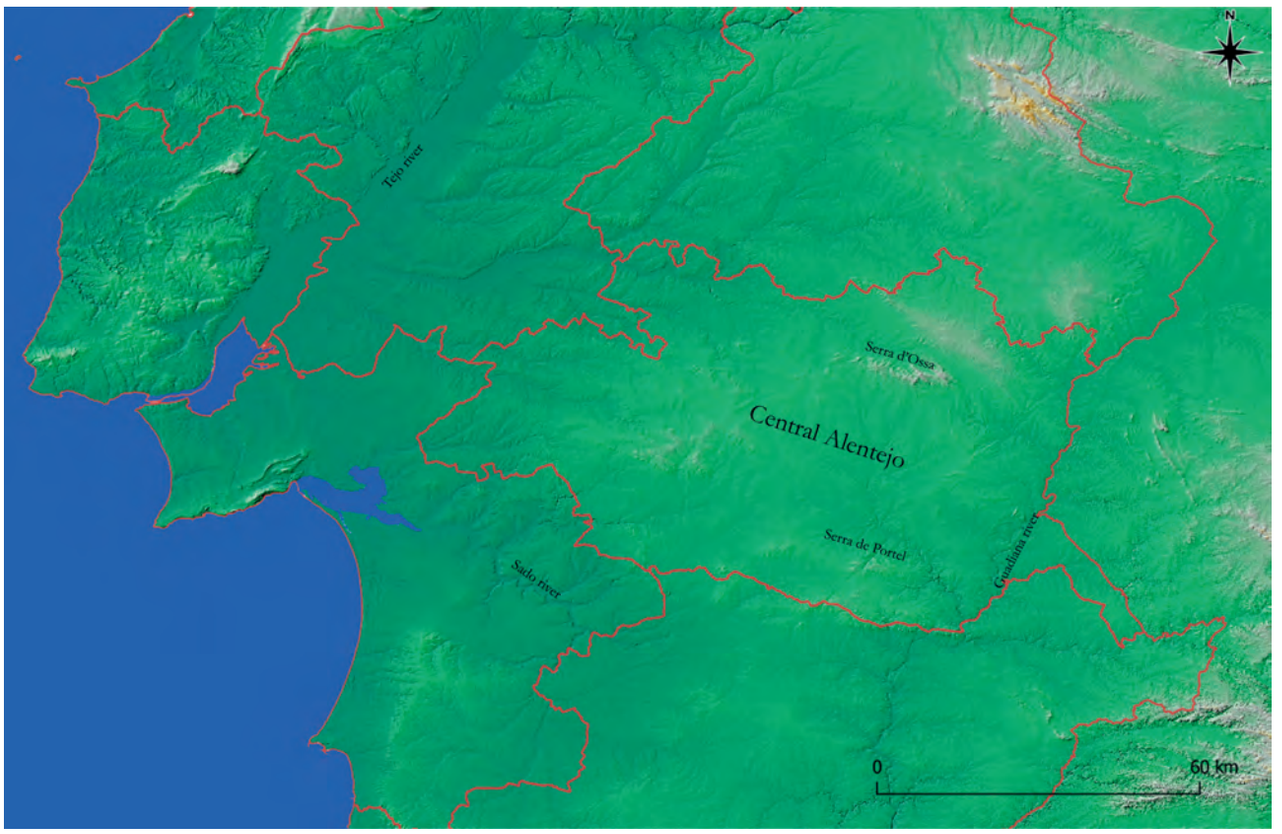


Figure 1. The Central Alentejo region in southern Portugal.

Keywords: Alentejo; settlement system; Serra d'Ossas landscape, memory.

Resumo

O Bronze Final no Alentejo é marcado pela ocupação dos cumes das maiores serranias onde extensos sítios, usualmente rodeados por um grande talude, se destacam na paisagem. Estas grandes aglomerações no topo das serras terão funcionado em redes solidárias, detinham uma visibilidade dominante da área e foram construídas intencionalmente para serem vistas por outros. Junto com estas ocupações, uma rede de sítios de pequena e média dimensão ocupava as colinas mais baixas com vista sobre a planície, onde algumas delas se implantavam.

Os sistemas produtivos da Idade do Bronze Final na região indicam a existência de um modo de produção doméstica e dispersa, levando à disseminação de métodos de produção agrícola, metalúrgica e têxtil partilhados pelas redes de povoamento previamente definidas. No Alentejo, a Idade do Bronze caracteriza-se por uma presença reduzida de expressões gráficas míticas e sagradas, por oposição à vasta diversidade encontrada em períodos anteriores. No entanto, existem numerosos indícios de um forte sentido de identidade enraizado nos Lieux de Mémoire criados pelas comunidades, como sugere a reutilização de monumentos megalíticos, tanto funerários como meníricos. Este processo de formação de identidade ocorreu principalmente no início da Idade do Bronze. Ao longo do tempo, as representações da panóplia do guerreiro e a iconografia associada, representadas em estelas de pedra, mudaram a nossa compreensão deste período. Durante a Idade do Bronze no Alentejo, a criação de memória foi parte integrante da agregação de comunidades. Estas comunidades, talvez movidas por um sentimento de insegurança, reuniram-se nos pontos mais altos da paisagem. Este movimento, ocorrido principalmente na segunda metade do segundo milénio a.C., coincide com a celebração de uma cosmologia mítica afiliada à iconografia heróica representada nas estelas de pedra. Em grande medida, esta rica iconografia guerreira parece ter resultado de uma preocupação transeuropeia com o conflito e a guerra.

Palavras-chave: Alentejo; sistema de povoamento; Serra d'Ossa; Paisagem; memória.

0. In southern Portugal, between the Tejo, Sado, and Guadiana rivers: mountains over the plains

The Alentejo is often associated with an endless plain, scorched and destitute, where the only source of shade is that which comes from the sky itself. This, however, is an oversimplified characterization that does not account for

Figure 2. The Serra d'Ossa mountain range, view from southeast.

the vast landscape diversity of the region. The Alentejo is marked by extensive natural pathways that facilitate mobility, particularly through small river basins, which respond rapidly to seasonal precipitation and tend to fill quickly during harsh winter months (Fig. 1).

The primary area in which our work will focus, the Central Alentejo, is generally associated with the district of Évora, characterized by open plains and rolling hills, from which prominent elevations and mountains emerge: Serra d'Ossa and the anticline of Estremoz in the north, and the Serra de Portel/Mendro in the south. These ridge lines are oriented in an approximately SE-NW direction, aligning with the landscape and resulting in large natural pathways. The Central Alentejo is a region clearly defined by the convergence of southern Portugal's three primary river basins, thus reinforcing its attribution as a great natural pathway between the descending course of the Guadiana and the mouths of the Tejo and Sado. Therefore, we believe it is important to highlight that this is a significant area of transition and passage – an extensive natural corridor connecting the middle Guadiana basin and the sea, whose long estuaries would have emerged much further upstream than they do today.

In general, even during the Bronze Age, this region had a harsh climate, generally poor and often stony soil, where the vagaries of rain, as throughout the Mediterranean, were scarce, until they came down in torrents.

1. The end of the Bronze Age in the Central Alentejo: landscape and settlement systems

Since the middle of the second millennium BC, the interior of the Alentejo appears to have been characterized by complex settlement networks structured around large population agglomerations which, organized in both solidarity and interdependent partnerships, would have coordinated the large territories surrounding the principal mountain ranges (Mataloto 2012).

These settlement networks included not only large occupations on hilltops, usually delimited by perimeter structures, but also a network of small- and medium-sized occupations, situated on elevations overlooking the plains or in open fields (Fig. 2).

The location of the largest settlements along prominent ridges, where they could see and be seen, allowed them to play a fundamental role in the management of movement. They were always, or nearly always, located at nodal points along natural pathways. This fact may have facilitated the rise of certain groups that could base their power on controlling and managing the circulation of goods and people, of regional and supra-regional origin, as proposed in other areas of the peninsular West (Vilaça 1998, 348), and Europe more widely (Kristiansen 2007; Kristiansen and Earle 2015). Such dynamics likely reinforced regional and inter-regional interactions, resulting in the emergence of inter-group alliances that would control the flow of circulation. The ties of a community with an area and an identity would have ultimately been strengthened, thus giving rise to processes of territorialization and consolidation of the social elements involved (Vilaça 1998; Pavón 1998).

The settlement systems developed around the Alentejo's primary mountain ranges, such as the Serra d'Ossa, Portel, or even the elevations of Monsaraz, would only be sustainable within a framework of close collaboration and solidarity between neighboring villages, helping to mitigate any potential latent conflict arising from resource pressure (Fig. 3). These societies, centered on the mountains, would have been integrated into regional solidarity networks, united by identity and family ties, which would allow them to integrate extensive networks of exchange and circulation, thus strengthening their position *vis-à-vis* the nearest settlement systems. However, the production systems associated with these communities at the end of the Bronze Age still seem to correspond to decentralized social units of family scope, thus resulting in the dispersal of evidence for agricultural, textile, and metallurgical production across the different settlement models, demonstrating an organization of labor with minimal hierarchy.

Currently, the region under analysis is characterized by a limited presence of mythical or sacred graphic expressions, in contrast to the enormous diversity known in previous periods, especially during the third millennium BC. However, there are some signs of a strong identity rooted in *lieux de mémoire*[5], through a reintegration into the landscape of megalithic monuments, both funerary and menhiric (Mataloto 2007; 2018).

[5] Places of memory - expression used by Pierre Nora (1989) to identify specific places where memory is built.

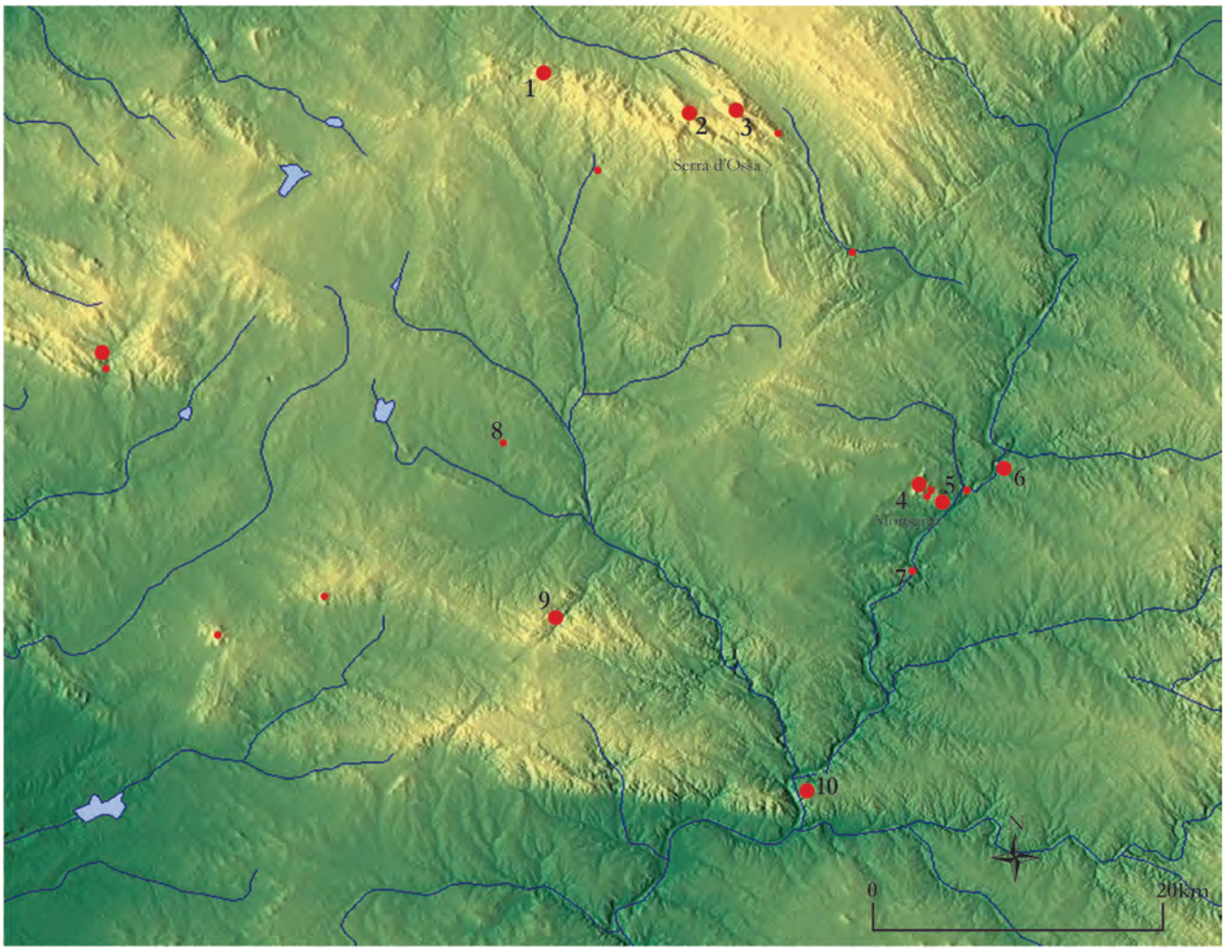


Figure 3. The main settlement systems from the Central Alentejo. Sites mentioned: 1 – Evoramonte: 2 – São Gens; 3 – Castelo Velho da Serra d'Ossa; 4 – Monsaraz; 5 – São Gens (near Guadiana); 6 – Molino Porras; 7 – Rocha do Vigio; 8 – Casarão da Mesquita 3 e 4; 9 – Serra Murada; 10 – Ratinhos.

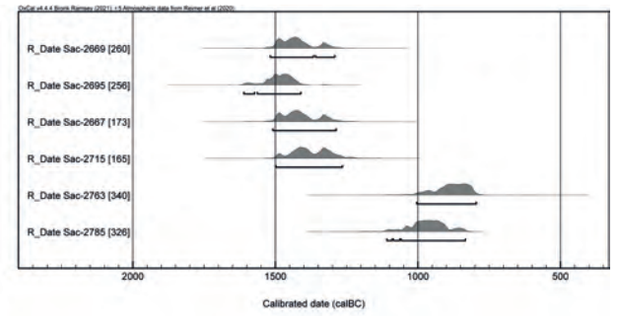
2. From the Serra d'Ossa to the Guadiana: solidarity settlement networks

The process of occupation along the highest hilltops in the Central Alentejo can be traced from the second millennium BC, considering the dates available from the Evoramonte stratigraphic sequence (Mataloto *et al.* 2013). This reflects a broader trend of occupation at high points in the landscape, documented from the beginning of the second millennium BC in the southwest of the Iberian Peninsula, at sites such as Alanje (Pavón 1998) and El Trastejón (Hurtado Pérez *et al.* 2011). The way in which these sites stand out in the landscape, occupying strategic locations for controlling transit both North-South and East-West, makes these large installations nodal points in the structuring of settlement (v. Fig. 3). These settlements typically feature significant perimeter embankments, possibly indicative of the presence of delimitation structures. However, archaeological work we have been conducting at Evoramonte, Monsaraz, and Castelo Velho da Serra d'Ossa suggest that these embankments may have been associated with the construction of platforms intended to extend the habitable area and exert some form of containment and delimitation, rather than functioning exclusively as walled defensive systems (Fig. 4). In this respect, we believe it is particularly important to consider the settlement of El Trastejón (Huelva), where this situation is well attested (Hurtado Pérez *et al.* 2011, 34). However, we acknowledge that in specific areas, some of these structures may have served as true defensive systems, such as those recorded at the sites of Castro dos Ratinhos (Berrocal-Rangel and Silva 2010, 235) or Passo Alto (Soares e*t al.* 2012, 251), though not necessarily constituting complex poliorcetic architecture.

These massive, enclosed occupations dating to the end of the Bronze Age –characterized by substantial delimitation structures, their construction in areas of difficult habitability, and their considerable size, sometimes extending across several tens of hectares– would have made it possible for hundreds, or even thousands, of individuals to gather at the top of the mountains. This would have generated communities with a strong influence on the structuring of settlement. We consider these mountain-centered settlement systems to be fundamental to understanding social

Figure 4. The Castelo Velho da Serra d'Ossa embankment, south side.

Figure 5. The Evoramonte hill.



EVM - Date	2s 95.4% probability
Sac-2669 [260]	1518BC (80.2%) 1366BC 1360BC (15.3%) 1292BC
Sac-2695 [256]	1611BC (5.8%) 1574BC 1564BC (89.7%) 1411BC
Sac-2667 [173]	1509BC (95.4%) 1287BC
Sac-2715 [165]	1498BC (95.4%) 1266BC
Sac-2763 [340]	1004BC (95.4%) 796BC
Sac-2785 [326]	1109BC (2.0%) 1092BC 1086BC (2.5%) 1064BC 1059BC (90.9%) 834BC

Figure 6. Evoramonte: dates available and Bronze Age hut and fireplace.

dynamics during the Bronze Age,which is why it is important to better characterize them. In central-eastern Alentejo, we have developed research on settlements that can be integrated into two of these systems: the Serra d'Ossa and Monsaraz, which we will present below (Fig. 3.)

2.1 The Serra d'Ossa Settlement Network

The Serra d'Ossa, previously presented as the center of an intense and complex settlement network (Calado 1993; Mataloto 2012), contains three of the most extensive hilltop occupations known in the Central Alentejo: São Gens, Castelo Velho da Serra d'Ossa, and Evoramonte. The latter stands out due to the vast size of the dispersion area of archaeological remains, covering more than 30 hectares, located on a hill above the plain at the northwest end of the mountain (Fig. 5). The excavation of a small area on the southeastern slope made it possible to document a long and dynamic stratigraphy from the Bronze Age, marked by the overlapping of occupation floors and fireplaces, associated with domestic structures made from perishable materials (Fig. 6). The C14 sequence obtained from bone samples made it possible to identify the beginning of the Bronze Age occupation from the middle of the second millennium BC, lasting until the beginning of the second quarter of the following millennium (Mataloto 2013). Of equal significance is the presence of ceramics with clear Meseta affiliation from the Cogotas tradition, featuring patterns associated with its classical period (Abarquero Moras 2005, 469) (Fig. 7), thus indicating the presence of long-distance cultural connections. The metal artifacts from Evoramonte are poorly documented, with only small awls and a knife; however, the discovery of a small gold plate bearing fluted decoration is particularly noteworthy.

The peak of São Gens, encompassing the summit of the Serra d'Ossa (Fig. 8), is located in a relatively central area along the mountain range, rising at the intersection of several ridgelines and dominating the two principal paths across the mountain: Meio Mundo to the east, and Convento to the west. Evidence of occupation extends over 10 hectares, occupying the flattened top of São Gens and a large part of its northern slope. This site was only briefly investigated, and an initial synthesis has already been presented (Mataloto 2004). The excavation at São Gens focused on an area adjacent to the summit and revealed a single phase of occupation, to which all associated architectural and artifactual remains correspond. These included minimal evidence of structures, made from perishable materials, and of an undetermined layout. This work docu-

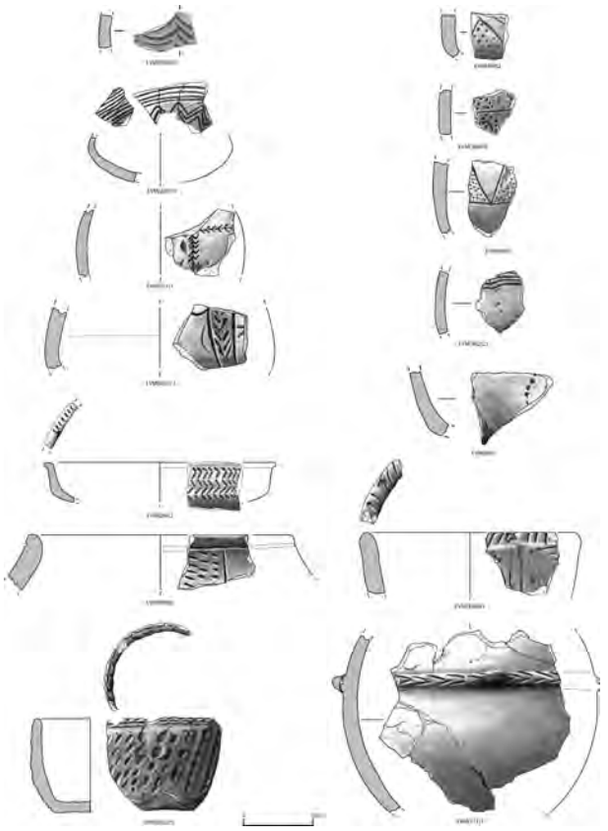


Figure 7. Evoramonte, decorated ceramic: Cogotas type decoration and others.

mented a ceramic group of local tradition from the end of the Bronze Age, to which was added a set of new forms of colonial origin or inspiration like the amphorae 10.1.1.1, the painted amphora, or the *pithoi*, already of regional production. Local shapes correspond mainly to bowls designed for individual consumption and open shapes, generally carinated, in addition to small-and medium-sized vessels with an "S"-shaped profile. Imports and wheel-made productions are primarily related to large storage and transport vessels.

Thus, if we consider the excavation results, São Gens is a very late settlement within the Bronze Age, probably between the 9th and 8th centuries BC, with a relatively short period of occupation. Unlike what was recorded at the large upland settlements mentioned above, careful analysis of surface collections at São Gens appears to indicate a relatively low occupation intensity, possibly indicative of a sparse and intermittent occupation at the top. We believe it is possible to consider the occupation of São Gens a meeting place, where relations between the communities that occupied the mountain were managed and mediated, as has been proposed for certain contexts in Northern Europe (Kristiansen 2010, 185; Thurston 2010, 228). The presence, at a late moment of the Bronze Age, of the first signs of wine consumption imported into the region and *pithoi* of local production, may indicate the occurrence of celebrations that involved a temporary stay at the top during specific times of the year. It is important to note that until

Figure 8. São Gens at Serra d'Ossa.

very recently, the annual festival of São "Cornelho" (Cornélio), the blessing of herds (primarily goats), took place on the hilltop of São Gens. This event, centered on offerings made at the rock of São "Cornelho", has been interpreted as a surviving remnant of an ancestral celebration (Moita 1965). This fact does not preclude the existence of limited permanent occupation at the site, as indicated by the presence of loom elements, grindstones, and evidence of metallurgy. The centrality and visibility of this site, combined with its relative accessibility, would facilitate its use as a place of aggregation and mediation between different groups, thus reinforcing the existing ties among the various settlements that would form a single community, all integrated into the same settlement system (Mataloto 2012).

The site of Castelo Velho da Serra d'Ossa (Calado and Mataloto 2001) is located on a prominent hilltop to the east of the *Meio Mundo* valley (Fig. 9). Evidence of occupation extends over approximately 14 hectares and appears to be surrounded by a structured delimitation embankment measuring approximately 1.5 kilometers in length. A recently excavated test pit revealed that this feature was constructed in successive layers of earth and interlocking stone, forming a broad terrace along whose edge a palisade-like structure made of perishable materials was constructed (Fig. 10). In turn, rather than a traditional defensive wall, the occupation of Castelo Velho would have been delimited by this large embankment (Fig. 4), which would have greatly expanded the habitable area along the hilltop, while the palisade allowed for the enclosure and protection of the interior of the inhabited space. The highest point of the settlement's interior had another terrace- or platform-like structure, built mostly in stone and measuring around 30 meters in diameter (Fig. 10).

On the dirt road that cuts longitudinally across the hilltop, several habitat structures were visible at the surface, such as the bases of various huts constructed with vertically placed schist slabs and several structural postholes. Excavation carried out on one of these structures, already partially visible at the surface, made it possible to document the overlapping of several large huts with an elliptical

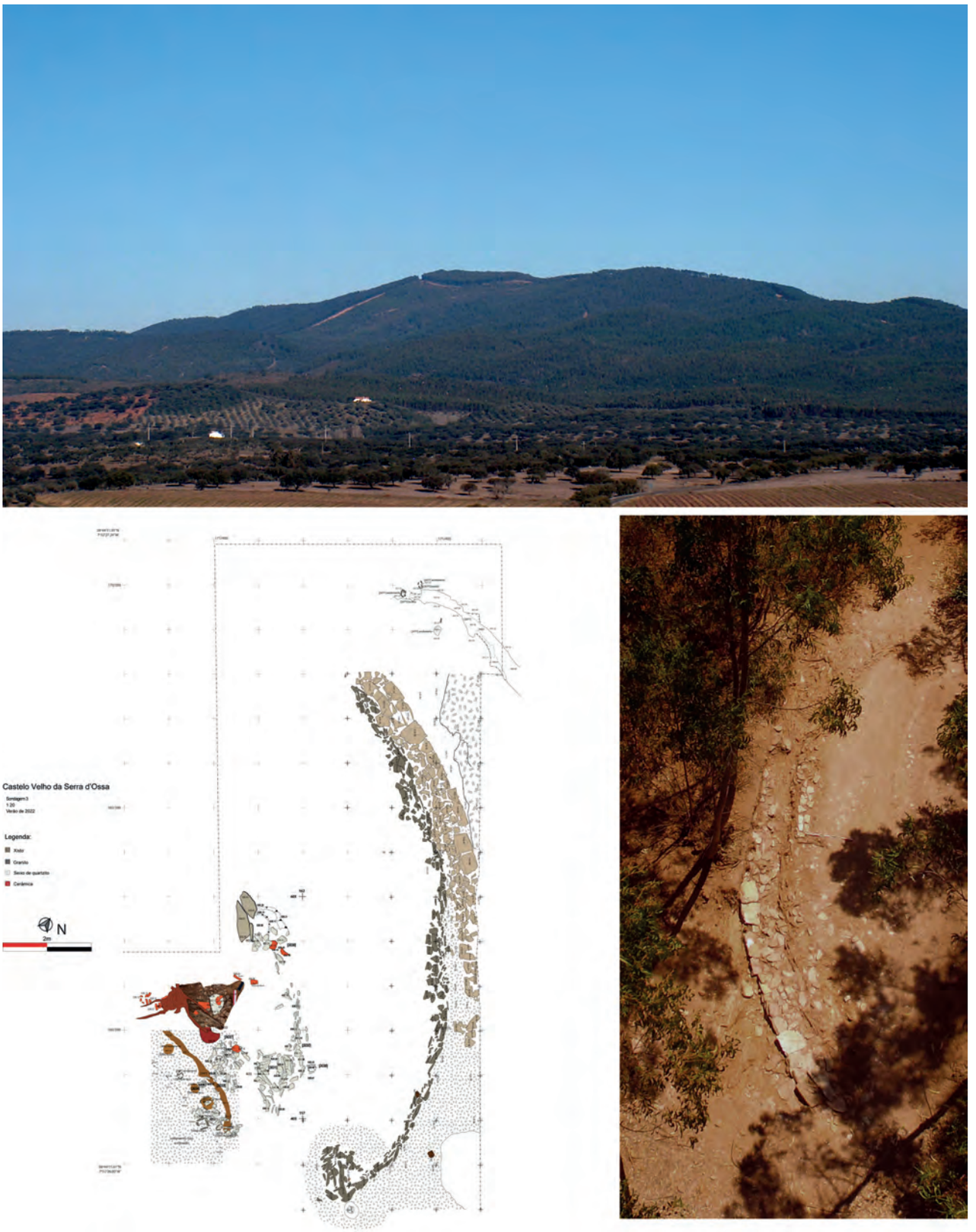


Figure 9. Castelo Velho da Serra d'Ossa hilltop; plan and image of the Bronze Age hut test pit.

shape, measuring approximately 12 to 14 meters long, with large postholes at the center (Fig.9). These structures appear to correspond to different moments of construction in the same space, equipped with a large central hearth consisting of a clay surface layered over a foundation of ceramic sherds. This was superimposed on several huts with a much smaller diameter, around 3 to 4 meters, but of similar construction, with a base of vertically placed schist slabs and postholes to support the roof internally. Although the precise chronology of these structures remain uncertain, the occupation clearly dates to the Final Bronze Age, given that there is an extensive ceramic assemblage with forms

Figure 10. Embankment or platform structure from Castelo Velho da Serra d'Ossa; (right) test pit 6, platform and palisade structure base.

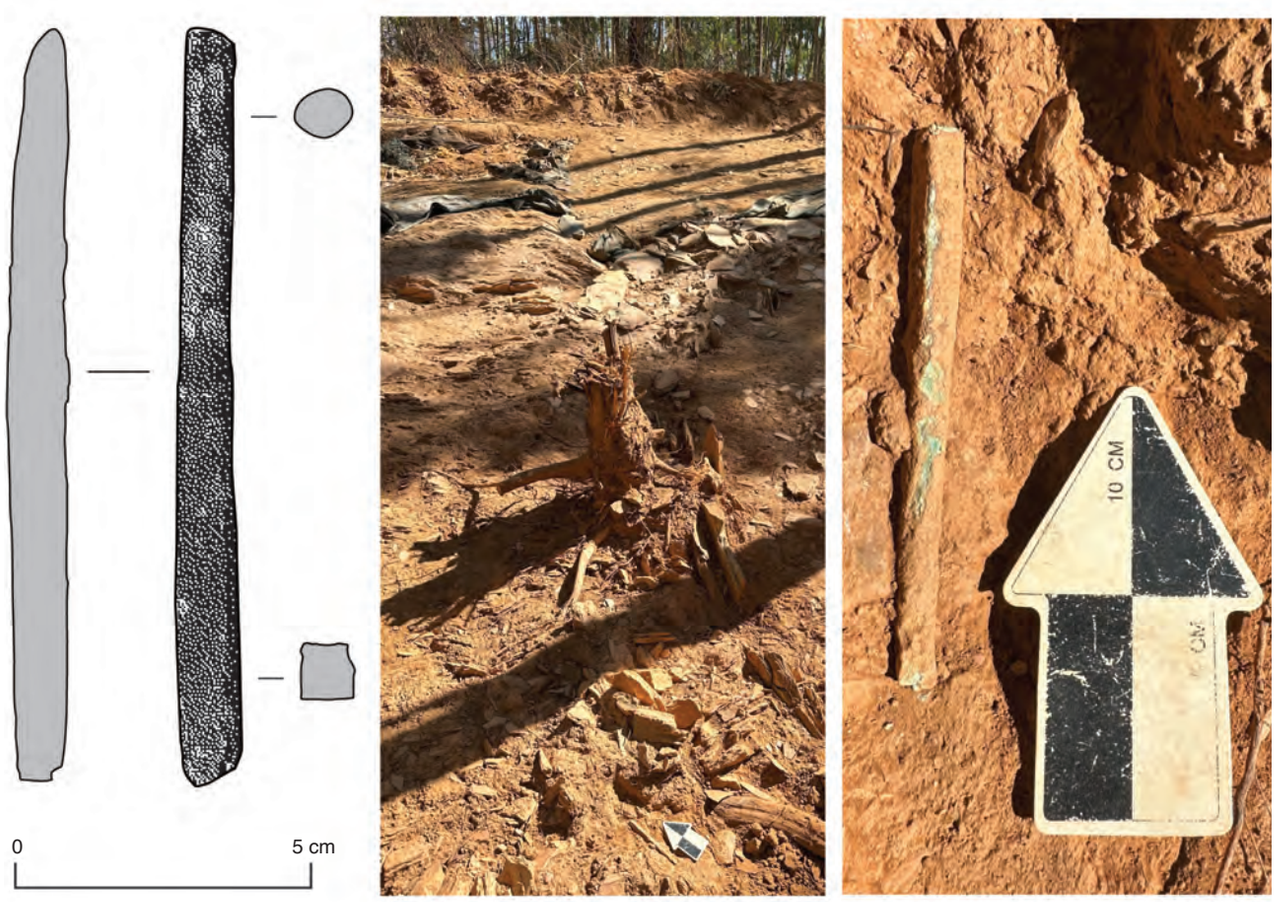


Figure 11. Castelo Velho da Serra d'Ossa chisel and hut from test pit 3.

Figure 12. Martes site, between the plains and the hills, view from the south; loom weights, triple mold, crucible sockted handles.

typical of this chronology in the region, sometimes with pattern burnished decoration. It is also important to highlight the presence of a bronze chisel, associated with one of the large elliptical huts (Fig. 11).

The overlapping of several huts in the same area, with an apparent evolution between those with a smaller dimension to a moment of very large structures, which may reach more than 200 m^2, is still difficult to interpret, especially due to a lack of datable materials recovered from the site. Nonetheless, the profusion of overlapping structures suggests, on the one hand, the scarcity of habitable areas, given the steep slopes, and on the other hand, a degree of occupational instability, as suggested by the sequential rebuilding of structures. Perhaps a bolder interpretation, the increase in the size of the hut between the oldest and most recent phases could indicate the strengthening of the nuclear family, which was progressively expanding and consolidating. However, further data are needed to substantiate this hypothesis. As we will mention later, structures similar to the more recent ones were documented in the highest areas at the site of Castro dos Ratinhos, giving some reinforcement to the idea of strengthening and expanding the family nucleus.

Although establishing a precise diachronic sequence remains challenging, we believe the site was occupied during the middle of the Final Bronze Age, with its abandonment likely associated with the emergence of new social dynamics introduced by Phoenician communities along the coast from the 8th century BC onward.

On the margins of the Serra d'Ossa, atop prominent hills overlooking the plain and seemingly controlling access to the mountain interior, there are several small Bronze Age occupations such as Martes, Fonte Ferrenha, and Roquina, with areas of around 1 hectare, and artifactual sets relatively similar to the larger settlements previously mentioned. At the settlement of Martes there are several signs of metallurgy, namely three fragments of casting crucibles with a socket handle (Calado and Rocha 1996-1997, fig. 7), in addition to a quadruple mold for axes and other undetermined objects (Mataloto 2013, 253), thus demonstrating that these small settlements would also have a diversified production structure, with some more specialized activities, such as metallurgy (Fig. 12).

In the plains surrounding the Serra d'Ossa, a group of small, scattered occupations has been identified, including the sites of Zambujal do Amigo, Paço da Quinta, and Sobral (Calado and Mataloto 2001, 78), among others. These sites may have been contemporaneous with the wider settlement network of the mountain, if we consider the presence of the characteristic pattern burnished ceramics found at some of them (Mataloto 2007, 150). In this region, the settlement model is still unclear. A few dozen kilometers south of the Serra d'Ossa, where it still dominates the horizon, several of these sites located in the plains have been excavated, allowing us to better understand this period. The various known cases are located in the Ribeira do Albardão valley, southeast of Évora, where four of these occupations were excavated, on both banks of the river (Fig. 13).

The sites of Casarão da Mesquita 3, the most extensively excavated and published (Santos *et al.* 2008), Casarão da Mesquita 4 (Nunes et al 2014), Monte da Cabida 3 (Soares *et al.* 2009), and Horta do Albardão 3 (Santos *et al.* 2009) are occupations characterized by their location on gentle hills adjacent to fertile agricultural land, and with a variable number of negative silo-type structures. Although these rescue excavations were carried out in relatively narrow strips, it was possible to record the presence of several dozen negative structures in the first two, which realistically may correspond to just one occupation (Nunes *et al.* 2014). These structures, usually more than one meter deep and with a frustoconical profile, appear in interesting concentrations

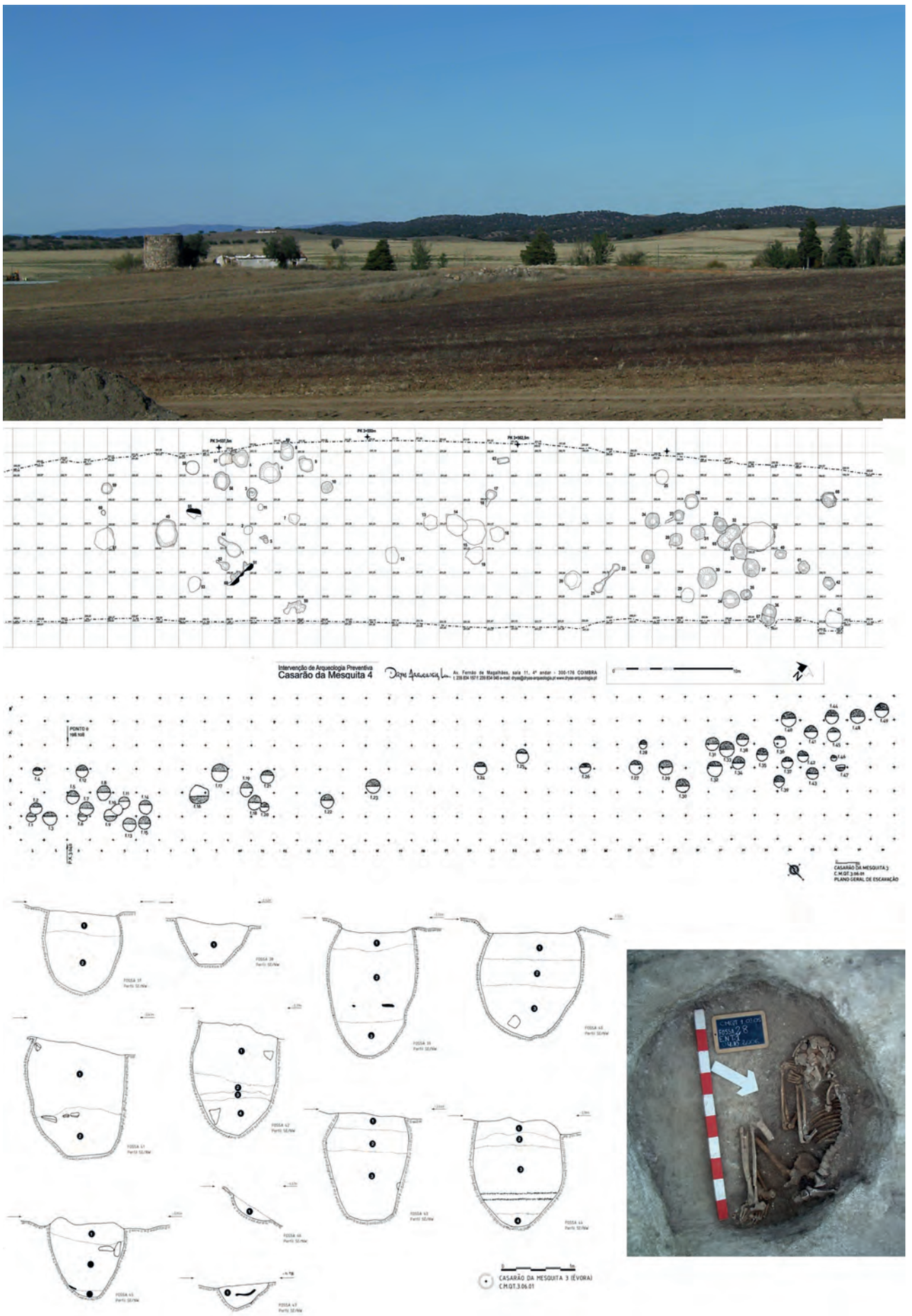


Figure 13. View from Casarão da Mesquita 3 to the north, with Serra d'Ossa on the far horizon; plan and section of Casarão da Mesquita 4 and 3 pits; burial from pit 28 of Casarão da Mesquita (after Santos et al. 2008).

of around two dozen, separated by tens of meters. This allows us to hypothesize that the voids are associated with seasonal housing spaces, as has been proposed for several sites in the Meseta (Blasco 2004, 364).

Necropolises or funerary depositions from the Final Bronze Age, generally unknown, are common in these types of lowland sites, with burials taking place inside these negative structures without forming formal necropolis areas.

These lowland occupations are usually interpreted as being seasonal in nature, associated with semi-nomadic agricultural communities. However, we consider this interpretation to be overly linear, as the material assemblages suggest a far more complex reality. On the one hand, based on radiocarbon dating primarily from Casarão da Mesquita 3, there is a notable continuity or recurrence of occupation, associated with an effective organization of space, deduced by the distribution of structures. Likewise, at Casarão da Mesquita 4, they are rarely divided, despite being concentrated in a relatively restricted area. This fact, even considering the long chronological sequences for the abandonment of structures, demonstrates an effective knowledge of the space and its organization far beyond its "memory". On the other hand, traces of domestic activities, such as weaving, have been documented, which is unlikely to have taken place in strictly seasonal contexts, particularly since these sites were probably used during periods of heightened labor demand, such as sowing or harvesting. Metallurgy is well attested at Casarão da Mesquita 3 and 4 (Santos *et al.* 2008; Nunes *et al.* 2014). Although it requires time and knowledge, it is an activity that can be considered complementary to agricultural practice, mainly in the production and repair of tools, such as the documented flat axes, possibly important in felling trees to expand cultivation areas.

Although we believe that the presence of burials within the fills of negative structures does not represent the establishment of true sepulchral spaces, the deliberate deposition of the dead is nevertheless evident. This may demonstrate rooting and fixation to the site, place-making through the burial of ancestors, with an increasing importance placed on spatial contiguity. These burials were revisited and reconditioned, sometimes with the purposeful removal and adjustment of parts of the individual, at a point when the body had not yet completely decomposed (Santos *et al.* 2009; Nunes *et al.* 2014). Based on these data, we believe that these occupations would have ended up hosting permanent communities dedicated to the agricultural management of the area. The occasional agglomeration of pits in relatively restricted areas, separated by tens, or even hundreds of meters, as is the case at Casarão da Mesquita 3 and 4, may indicate a form of rural occupation in the form of a dispersed settlement, as documented at the beginning of the Iron Age in the region (Mataloto 2004a). In the best characterized areas, the settlement networks that make up the various settlement types presented here appear to us to be quite dense and diverse. However, the factor of time is still quite complex to manage without having extensive radiocarbon sequences available. The sets of dates available for the different settlement types allow us to confirm that they would have, at least partially, been contemporary. At the moment, for the Serra d'Ossa settlement network and its immediate area, we have radiocarbon dates for the occupations of Evoramonte (Mataloto 2013), Casarão da Mesquita 3 (Santos *et al.* 2008), Monte da Cabida 3 (Soares *et al.* 2009), Casarão da Mesquita 4 (Nunes *et al.* 2014), and Horta do Albardão 3 (Santos *et al.* 2009). These sites encompass the various settlement types discussed above, making clear, we believe, the possible contemporaneity between them.

The Serra d'Ossa would have been the center of a structured settlement network, anchored by large population clusters situated on the most inaccessible hilltops of the mountain, but also encompassing a diverse range of settlement types, united by supportive and interdependent social, political, and economic ties. In fact, we believe that only substancial human pressure and tension over resources and communities could have justified the relocation of significant portions of the population to such inhospitable upland locations –where essential resources, including cultivable land and water, were situated at a considerable distance. On the other hand, significant solidarity and social cohesion would have been necessary to build and maintain notable delimitation structures, such as the extensive embankments at Castelo Velho. In any case, these large upland settlements would have to be closely connected with both the settlements on prominent hills that controlled natural access paths to the mountains, and with the lowland settlements in the plains, such as those that dealt most directly with the agricultural management of the territories. The varied and decentralized production of both metal and textile, in addition to agriculture, makes it clear that the ties between these communities would not be one of coercive and hierarchical dependence, but rather supportive and complementary, likely united by ties of identity and ideology.

Although this interpretation is derived from the region under direct investigation, similar dynamics can be tentatively identified in adjacent areas, such as the Monsaraz mountains along the banks of the Guadiana, suggesting a broader regional pattern.

2.2 The Monsaraz Settlements Cluster (Fig. 14)

The elevation of Monsaraz appears to have been occupied by an extensive settlement from the Final Bronze Age, sur-

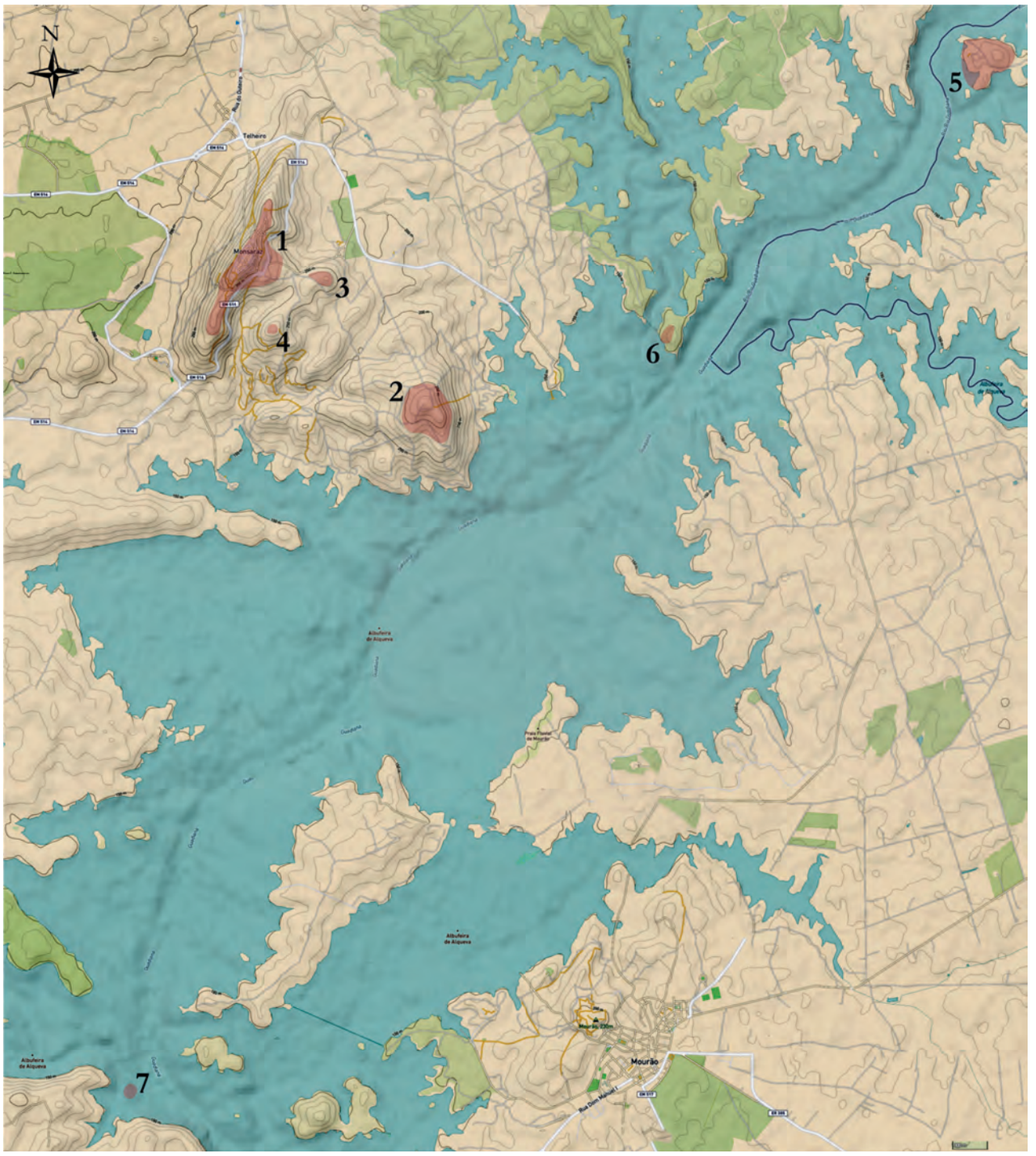


Figure 14. Monsaraz settlement system: 1 – Monsaraz; 2 – São Gens; 3 – Alto da Forca; São Lázaro; 5 – Molino Porras; 6 – Rocha do Vigio.

rounded by an evident perimeter embankment, very similar to the one documented at Castelo Velho da Serra d'Ossa, and encompassing more than a dozen hectares (Fig. 15).

At this location, only a small area was excavated, close to the highest point of the elevation, where the keep is located. Here, it was possible to document an interesting Final Bronze Age stratigraphy associated with a terrace-type stone structure, built with large slabs, which would have served to regulate the steep slopes and favor occupation (Fig. 16). It was possible to recover an abundance of ceramics from this period, including a rich and diverse set of ceramics with pattern burnished decoration. From this phase, we obtained a date that fits within the 9th century BC (Beta-364592 – 2720 ±30 BP - Cal BC 920 - 810 a 2s) (Fig. 16). Elsewhere on the hill, it was possible to document signs of generally contemporary occupation, as in the recent intervention in the church of Nossa Senhora da Lagoa, or in the excavation by Nuno Pedrosa in the outskirts of Corro, on the eastern slope, where a small deposition of two bronze bracelets was documented. These bracelets, both in bronze, have distinct characteristics: one being decorated with slight incisions, and the other plain. It is worth noting that the first is a ternary bronze (2,1% in

Figure 15. Monsaraz settlement system: (top) São Gens and Monsaraz seen from Molino Porras; (center) Monsaraz hill top: (bottom) São Gens in the center, Alto da Forca and São Lázaro, to the sides.

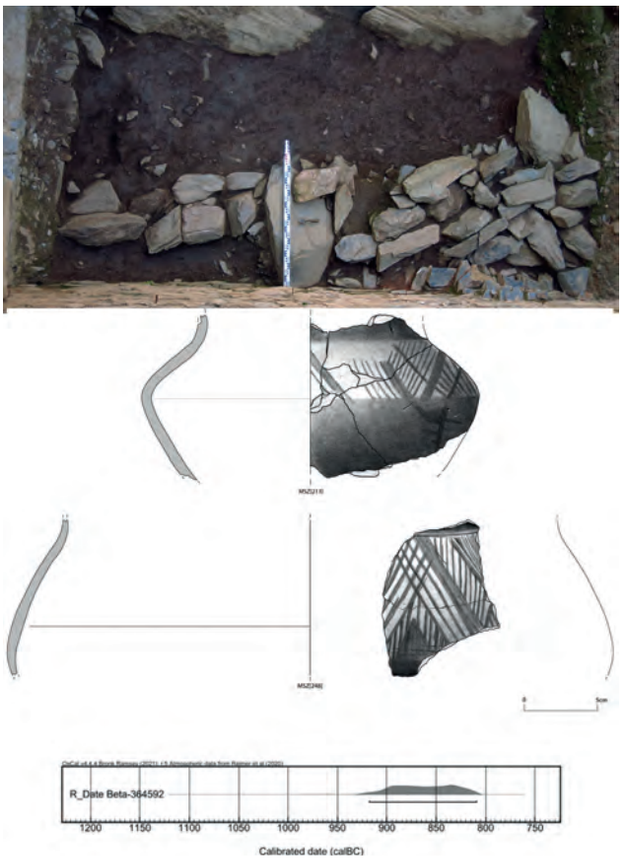


Figure 16. Monsaraz test pit: stone platform, pattern burnished decorated ceramics; dating to the Final Bronze Age.

weight of Pb), in a region with a metallurgy composed almost exclusively of binary bronzes at the end of the Bronze Age (Valério *et al.* 2018, 7). Bronze alloys with lead in this period are more commonly associated with Atlantic Europe, and this bracelet from Monsaraz could have been produced in more northern regions (Valério *et al.* 2018, 7).

Monsaraz constitutes the most prominent occupation in a dense settlement network located between the Monsaraz hilltop and the banks of the Guadiana River, a few kilometers to the east (Fig. 14 and 15). Close to Monsaraz and overlooking the Guadiana River is the elevation of São Gens (not to be confused with the previously discussed São Gens, located in the Serra d'Ossa mountain range), which is surrounded by an extensive embankment that appears to be constructed of earth and stone. It is approximately 14 hectares and is similar to the one documented at the site of Castelo Velho da Serra d'Ossa. Archaeological work has not been undertaken at the site. However, the foundations of several subcircular huts, post holes, and fireplaces are visible at the surface, indicating that this hilltop also comprises an extensive habitational occupation from the end of the Bronze Age. Between São Gens and Monsaraz, several other upland occupations with steep slopes and perimeter embankments have been identified, including São Lázaro and Alto da Forca, though they are significantly smaller, around 1 hectare in size (Fig. 14 and 15).

This settlement network appears to have controlled access to and from the area where the Guadiana River was easily fordable. The hypothesis that this section of the Guadiana River was controlled during the Bronze Age is reinforced by the recently identified and impressive settlement of Molino del Porras[6]. This site is located on the left bank of the Guadiana River, less than 10 kilometers NE of Monsaraz, and is equipped with a strong fortification structure that delimits the settlement to the East, with the rest of the site opening toward the river, covering an area of approximately 20 hectares. The fluctuation of the dam's water level has exposed several stone structures, some quite large, resembling those we have recorded in the Serra d'Ossa region. The presence of a wall facing inland, with the rest of the settlement oriented toward the river like an amphitheater, allows us to identify its strong connection with the Guadiana River and its crossing (Fig. 17).

A short distance from and contemporary with the settlements of Monsaraz and São Gens is the settlement of Rocha do Vigio, clearly integrated into this settlement network, located only a few kilometers to the south, near the

[6] Site identified through the Lidar survey – PNOA Spain by Gil Vilarinho, and confirmed by us on the ground.

Figure 17. Molino Porras: Lidar PNOA image and possible embankment plan (special thanks to Gil Vilarinho). Stone structure has been partly washed out by the dam; base of stone circular structure.

mouth of Ribeira do Álamo. The site, which has been partially excavated, is located on a small rocky spur with steep slopes, measuring approximately 0.5 hectares in size, and delimited by an embankment. The site is currently submerged by the Alqueva dam. The archaeological work carried out at the site made it possible to record a single occupation associated with several overlapping oval-shaped structures in addition to a complex building of a quadrangular plan which is probably associated with a later period than the one under discussion here.

Three overlapping huts were recorded in half of their length, built in stone and perishable materials, and covered in clay (Fig. 18). These were built on the edge of the occupation area, partially on an embankment, constructed with large sub-horizontal stones and earth. The overlapping of huts associated with a relatively small area, artificially enlarged, may indicate a high level of land occupation. The construction sequence has been detailed previously (Mataloto 2009, 282), though it is important to highlight that the most recent hut, circular in shape, covered approximately 16m^2. A ^{14}C date was obtained from this context (Wk 18496: 2645 ± 33 BP), which places it between the end of the 10th century and the beginning of the 8th century BC.

The most recent hut must have corresponded to a typical domestic context of this period in the region as it was built with vertically placed slabs that would have supported a structure made of perishable materials (posts and intertwined branches), covered in clay, made evident by the burnt clay recovered from this context. The interior of the living space was divided by a bench, with large storage vessels lying on both sides of the floor (Fig. 18). The hut also contained elements related to metallurgy, one of the activities well-documented in the settlement, given the presence of a part of a bivalve mold for bronze chisels, as well as the presence of a high-quality iron chisel (Araque Gonzalez *et al.* 2023, 7). The latter appears to attest to interactions with exogenous entities, probably of Mediterranean origin. The presence of a *tuyère* with a quadrangular section may indicate a knowledge of new metallurgical technologies, possibly iron, as this type of artifact, which is found in the Iberian Peninsula following contact with the Phoenician colonial world (Renzi 2007, 175), typically stems from contexts associated with iron metallurgy. We believe that the site of Rocha do Vigio must have been a small metallurgical settlement, located on the outskirts of the settlement network structured around the Monsaraz mountains. However, despite its small size, it may have assumed great importance in this context, given the presence of relatively innovative materials and technologies at the end of the Bronze Age.

A few kilometers upstream of this site, also on the bank of the Álamo river, a lowland settlement in the plains was surveyed: Monte do Outeiro 2. This settlement has a chronology generally coeval with Rocha do Vigio (Calado *et al.* 2007, 138). The collection of a phytomorph pendant in carnelian or a similar stone, with various parallels in the south of the Iberian Peninsula and at the Mediterranean level (Gomes 2018, 61), allows us to understand that, despite its rural nature, Monte do Outeiro 2 would have been integrated into a large settlement network during the Final Bronze Age, such as Monsaraz– a network capable of attracting and redistributing these foreign articles to even the smallest of occupations. In a recent synthesis of carnelian pendants, it was noted that they clearly appear at an advanced stage of the Bronze Age, their presence continuing or resurging until the 6th century BC (Gomes 2018, 68). Its distribution may be related to the earliest Phoenician presence from the coast– something that the Rocha do Vigio chisel also makes clear.

In addition to Monte do Outeiro 2, several other rural lowland settlements have been identified in the plains surrounding Monsaraz, or next to the riverbank, such as Monte de Sousel, Barrocalinho 14, and Monte de Calvinos 5.

An examination of the settlement network of the Monsaraz mountains at the end of the Bronze Age allows us to get a better approximation of the underlying complexity

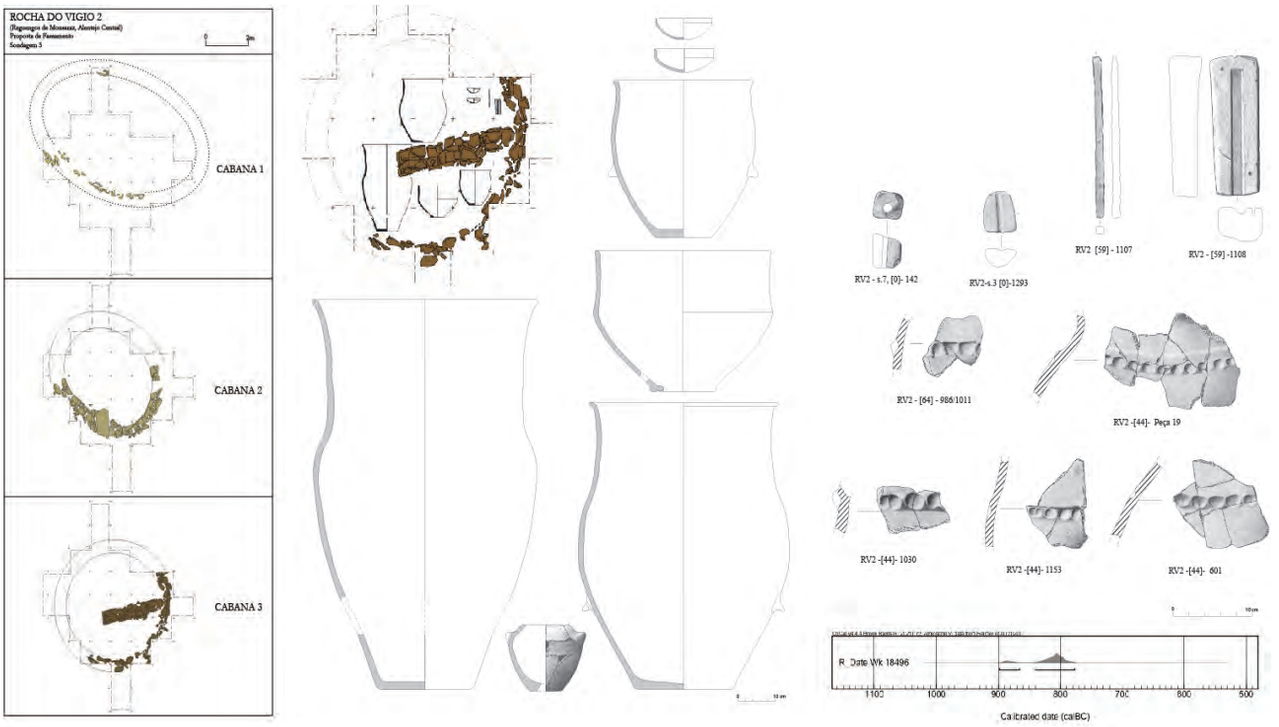


Figure 18. Rocha do Vigio: hut plans, and ceramic vessels, chisel and chisel mold found inside the last hut; date range from last moment of occupation.

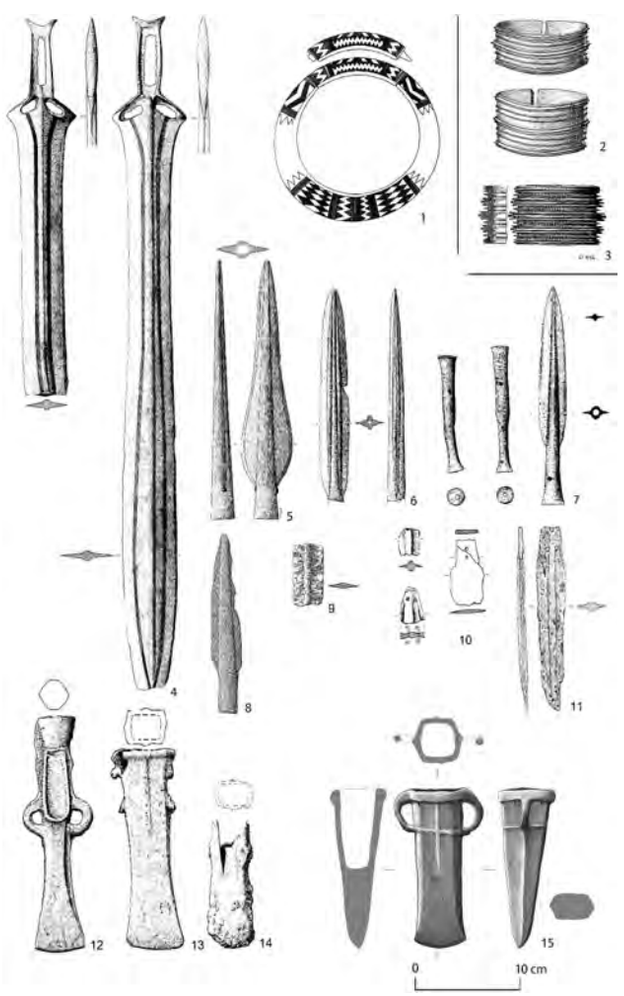


Figure 19. Jewelry and weapons from the Final Bronze Age of the Central Alentejo.

of the social, political, and territorial organization of the Final Bronze Age in the region. This network brings together several types of sites, consisting of settlements of varying size, and different kinds of location and aggregation strategies, where technologies, objects, and possibly foreign people circulated.

3. Power and identity in the Central Alentejo at the end of the Bronze Age

Various gold ornaments have come from the Central Alentejo; the Estremoz bracelet, the Portel necklace, and the Redondo and Arraiolos bracelets are among those that have survived to this day, while the Évora bracelets and Monsaraz necklace are among the missing (Coffyn 1985; Pingel 1992; Armbruster, 2000; Armbruster and Parreira 1993; Correia, 1993). This region presents one of the most notable concentrations of these ornaments from the end of the Bronze Age, which we can generally associate with the great settlement networks of this period, such as the Serra d'Ossa and the Monsaraz, but also to the Serra de Portel settlement network (Mataloto 2012).

While many gold ornaments have been identified in the Central Alentejo, bronze weapons are scarce, although several finds of great importance are known, such as the Évora swords, the Évora and Veiros spearheads (Schubart 1975; Coffyn 1985), the Alqueva deposit (Cardoso *et al.* 1992), the "Porto de Mós" type dagger from Arraiolos (Correia 1988), and the socketed ax from Soeiros (Mata-

loto 2022, 20) (Fig. 19). These were possibly produced locally, if we consider the molds discovered at the sites of Castro do Ratinhos (Berrocal-Rangel and Silva 2010, 311), Coroa do Frade (Arnaud 1979, 69), and Martes (Mataloto 2013, 253). The presence of these metallurgical assemblages ensures the integration of this region into a broad interaction network, where not only objects and their casting moulds circulated, but also an underlying concern for defensiveness and warriorship was spread. Throughout Europe, the end of the Bronze Age is typically associated with the spread of significant warrior panoplies, associated, according to some, with true warlords (Kristiansen 1999, 181). In turn, we believe that the existence and display of both ornaments and weaponry were crucial in the construction and consolidation of identity groups associated with the settlement networks of the Final Bronze Age in the region we have been analyzing.

The societal dynamics centered on the mountains should be integrated into regional solidarity networks united by identity and family ties, allowing them to participate in broad networks of exchange and circulation, thereby strengthening their position vis-à-vis the closest settlement systems, with ornaments and weaponry essential to this shared identity. This interpretation, which led us to consider the emergence of true *Senhores das Serras* (Mataloto 2012), is based on a structured vision of settlement and the society that underlies it.

However, we are certain that we cannot interpret these social groups as strongly stratified, or with reduced social mobility approaching proto-state organization. Thus, without the existence of social and settlement differentiation, we conceive the Final Bronze Age as moment when society was still largely based on family kinship structures and domestic-level production, from which socially prominent individuals began to emerge in certain lineages, accompanying more dynamic and complex perspectives on the means of domestic production itself, moving us away from Sahlins' more linear theories regarding modes of production (Delgado 2001, 464). Perhaps the vast construction dynamics documented at sites such as Castelo Velho da Serra d'Ossa, with the succession of several large housing structures in the same location, reflects these processes, but also the inconsistencies of these kin and broader social dynamics during the Final Bronze Age in the region.

In Central and Northern Europe, sociopolitical models have been proposed that imply a political, social, and economic structuring that is difficult to envisage in the Central Alentejo (Kristiansen and Earle 2015). Typically, these models are based on chiefdom structures and are interpreted as a "decentralized archaic state" where, despite the difficulties of centralizing productive systems, a clear social and territorial hierarchy is documented, where individuals detached from the productive structure would control, from central settlements, the tribute of the peasant population, to maintain groups of warriors and specialized artisans (Kristiansen 1998, 48; Kristiansen 2007, 61; Kristiansen 2010, 169). If we only consider the different occupation models already discussed for the interior of the Alentejo, with distinct dimensions and implementation and aggregation strategies, it becomes possible to understand these settlement networks from a highly structured and hierarchical perspective (Soares 2005; Mataloto 2012; Serra 2014). However, although we know little about the internal structure of the settlements, we have not yet documented clear evidence of strong economic and social differentiation, whether within or between settlements. Likewise, there is no evidence of control over production, particularly metallurgical or agricultural, and highly specialized occupations are also non-existent, although some, such as Rocha do Vigio, may be closely linked with metallurgy.

Given this overview, we believe that great caution is required when interpreting highly hierarchical systems, and alternative models of social and political organization must be sought, moving away from the rigid social paradigms presented by Service (1962). To better understand the social and political structuring of the Final Bronze Age in the region we have been analyzing, we believe it is important to look for less rigid models of organization (Kienlin and Zimmerman 2012; Thurston 2010), which move away from clearly hierarchical proposals, possibly of a heterarchical nature (Crumley 1995), which allow for a deeper connection between different dynamics, without the prejudices inherent in the models previously available (Harding 2000, 391). In fact, even in the best-studied regions where, according to some, a state-based and strongly hierarchical social structure is documented during the Bronze Age, it appears to occur in a slightly earlier period (Lull *et al.* 2009; Aranda Jiménez 2015), and other proposals have come to contradict this perspective. Social differentiation, although inevitable, would not have left a significant mark, as it did not, if at all, allow the removal of the most prominent individuals from productive activities (Bartelheim 2012). Although the systematic genetic studies carried out in La Almoyola have allowed us to attest to signs of a patriarchal society with great female mobility (Villalba-Mouco *et al.* 2022), they do not provide insight into the formation of lineages of succession for power transmission.

Returning to the Central Alentejo, we believe that the presence of heavy gold ornaments previously mentioned likely indicates the existence of social elites who played a significant role not only in coordinating large agglomerations atop the mountains but also in exerting influence over the broader surrounding territory. In our opinion, this possibility does not necessarily have to result from any co-

ercive action, but rather from the ability to generate centripetal solidarities, based on acts of alliance between entities and individuals. The wearing of emblematic symbols of power such as heavy gold ornaments, signifying transregional interactions, would have played a central role in the affirmation of the community's identity around a socially prominent individual or family.

The development of these symbolic displays of identity would have been crucial for the structuring of groups, which were still very dependent on primary organizations, based on family ties. This would be a way of keeping the group cohesive without resorting to political-military coercion. The group's cohesion would have been consolidated in assemblies, held seasonally, which would mediate the transmission and distribution of power between the different family units, centered on the designated head of household (Barceló 1995, 585). These individuals, who would embody family interaction networks, would choose a "*primus inter pares*", which would come close, despite criticism to more traditional theories, to the Homeric *Basileus* (Crielaard 2011), upon whom the function of coordinating the different communities would fall. They would be accompanied by significant warrior panoplies and ornaments with a strong sense of identity displayed as a sign of the sealing of inter-group reciprocity pacts, as was proposed long ago (Ruiz-Gálvez 1988, Fig. 2). However, the social order, particularly in these family-based formations with a relatively analogous background, would have still been strongly dependent on trust and solidarity, requiring continuous regulation and mediation of power, with a view to its effective legitimization, having to develop a purpose that guides the delivery and management of the same power (Eisenstadt 1988, 240).

However, the social and settlement model, where the power system would be based on a social structure that was still essentially egalitarian, and based on intra- and inter-family alliances, would tend towards a new social paradigm in which the emerging individuals would consolidate their position. This would eventually lead to the establishment of a true clientele group, breaking from the previously established elective and family reciprocity base. This attempt at individual consolidation of power would come up against the economic and technical limitations of a society based on an essentially domestic productive system. In turn, we believe that the attempt to move towards a state or proto-state organization, with sufficient aggregating capacity to keep territories together, no longer on an elective and redistributive basis, but on a coercive basis, would have given rise to enormous internal tensions and imbalances that would ultimately lead to the disintegration of these broad settlement networks at the end of the first quarter of the first millennium BC. In this aspect, the so-called "Collapse Theory" by J. Tainter (1988, 121), is particularly clear in demonstrating the difficulty of maintaining a certain level of complexity, without this being accompanied by new productive, political, and technical forms, capable of supporting constant transformation, eventually leading to the exhaustion of the system and its collapse. However, if on the one hand we think that the dismantling of this social system was essentially due to internal causes, on the other hand it is still interesting to see that it coincided with the start of Phoenician colonization in the south of the Iberian Peninsula, and later the Atlantic façade. We believe that this was precisely the process that resulted in the complete dismantling of the Final Bronze Age settlement networks from Central Alentejo in the transition to Iron Age.

4. *Crom, I never prayed to you before*[7]… Identity landscapes and the difficulty of finding sacredness in the Bronze Age of the Central Alentejo

The end of the Bronze Age in the Central Alentejo appears to be characterized by a structuring of the landscape with a focus on the living and sees a distinct lack of "ritual" or burial sites. It is during this period that we see the installation of settlements atop the highest mountains, gaining notable visibility not only by their placement, but also by the construction of embankments that give the appearance of massive defensive walls, similar to those documented at other sites on the left bank of the Guadiana, like Castro dos Ratinhos (Berrocal-Rangel and Silva 2010) or Passo Alto (Soares *et al.* 2012) as mentioned above. While these delimiting structures often appear to be vast defensive walls, they typically consist of stone and earth construction placed atop the mountain's natural bedrock, giving the appearance of being defensive in nature, though they may have been more symbolic than practical. While a concern for visibility is evident at these upland settlements during the Final Bronze Age, there is an apparent invisibility in terms of burial spaces. However, the well-attested reuse of megalithic monuments during the Bronze Age (Mataloto 2007, 132) can be integrated into the construction and consolidation of certain lineages through the personal or community appropriation of these ancestry traces.

If at the end of the Bronze Age the domestic and collective spaces gained greater visibility in the landscape, the cosmologies of these societies did not materialize, in a significant way for us, in the architectural and artifactual assemblages, with this period being absolutely aniconic in contrast to the profusion of idols and *idoliformes* present in domestic spaces during the third millennium BC (An-

[7] Conan the Barbarian (1982) - *The Battle of the Mounds*.

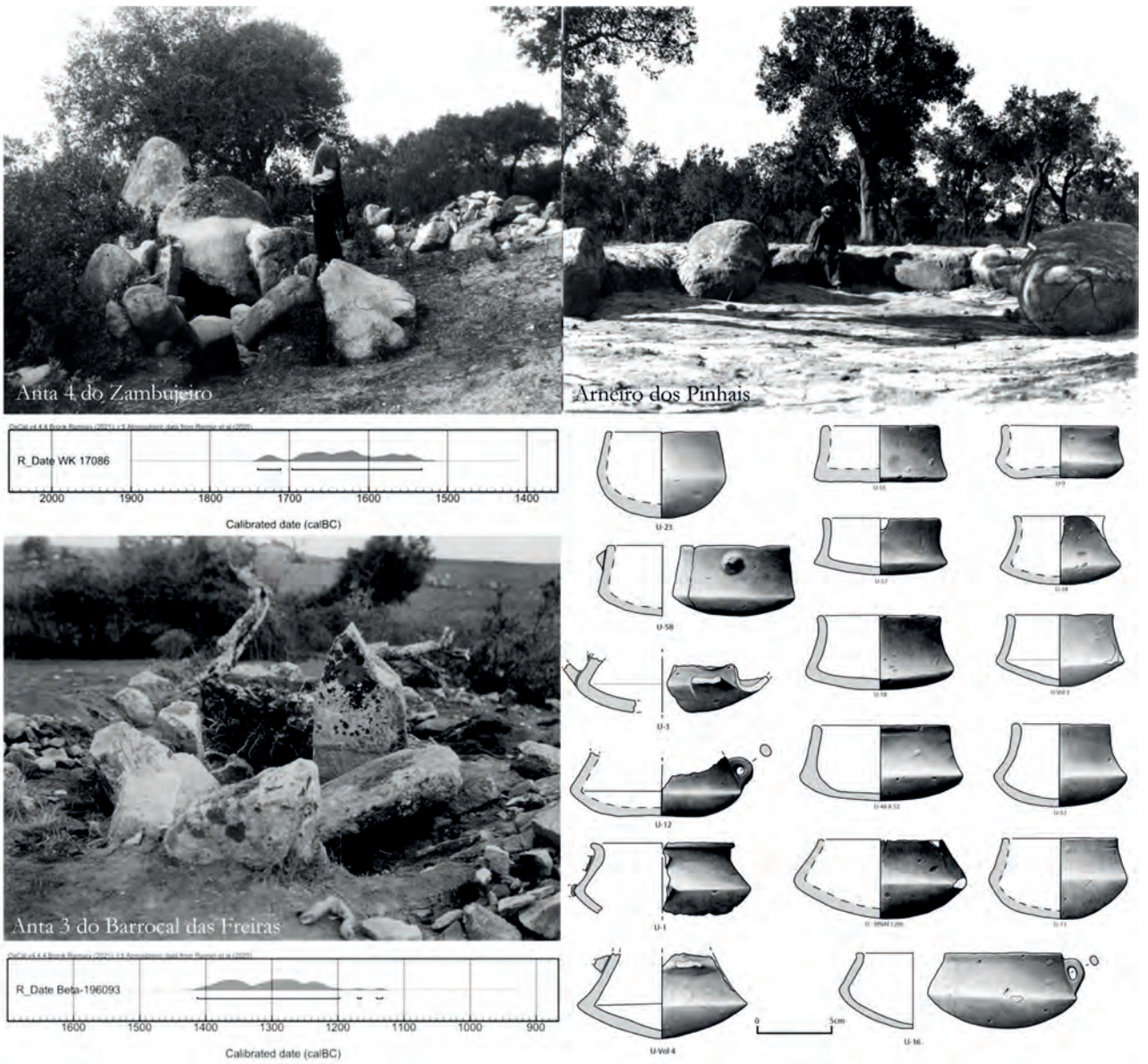


Figure 20. Megalithic monuments used during the 2nd millenium BC; Anta 3 do Barrocal das Freiras, date of Bronze age burial; Anta 4 do Zambujeiro, date of Bronze age burial; Arneiro dos Pinhais Cromlech, ceramic from a ritual deposit. (images of M. Heleno Archive, Museu Nacional de Arqueologia: Barrocal_das_Freiras_3 Cx1Env071_h; Zambujeiro 4 Cx1Env048_b; ArneiroPinhais Cx1Env119_a.

drade *et al.* 2021). Indeed, the beginning of the Bronze Age in southern Portugal seems to be marked by the total collapse and dismantling of Neolithic cosmologies (Valera 2015), leaving an apparent void in the Central Alentejo region that has been difficult to fill.

Given the multiplicity of sacred and generally anthropomorphic representations throughout the third millennium BC, an almost iconoclastic Bronze Age stands in contrast, where the representation of divine entities disappeared from every day and funerary contexts, while emerging, in the Alentejo, on rare stelae and some scarce rock art (Baptista and Santos 2013). However, evidence about the cosmologies and beliefs of Bronze Age communities in the Central Alentejo throughout the second millennium BC has been tentatively emerging. It is usually associated with Neolithic megalithic monuments, highlighting identity formation through ancestral heritage and a need to root communities to an ancestral Past, as the reuse of menhirs as stelae also makes clear.

The way in which megalithic enclosures and constructions contributed to the formation of an idea of the Past during the Bronze Age has been recorded throughout the southern Iberian Peninsula (García Sanjuan 2005; Lorrio 2008; Mataloto 2007; Aranda Jiménez 2015), enlightening us regarding the transition from old cosmologies to new rituals through the integration of perennial lifeways and a Past, more mythical than real, into a new worldview. We believe that this ontological shift is more than a representation of acts of resistance, or an "involution" to the profound transformations that have occurred or are underway, as has been proposed for other contexts in the Iberian Peninsula (Aranda Jiménez 2015; Aranda Jiménez *et al.* 2017).

We believe that in the western Iberian Peninsula, this ontological shift derives from a complete disintegration of the previous reality, which led to the shattering of the Chalcolithic communities and their worldviews. This fact imposed new forms of aggregation that generated new collective acts to reinforce the social ethos, which probably translated to, either the integration of ancient monuments into their world as means of legitimizing a mythical construction of common ancestry, or the constitution of sacred spaces that required cyclical use, necessary for the formation of this sense of belonging. On the other hand, the funerary deposition of some community members in ancient megalithic tombs clearly represents this distinct need to get closer to the ancestral past (Fig. 20).

In the Central Alentejo, especially in the westernmost region, ritual uses of ancient cromlechs and menhirs have been identified, likely during the Middle Bronze Age, as evidenced at the so-called Anta "U" (Fig. 20), at the menhirs of São Sebastião, in the cromlech of Portela de Mogos (Mataloto 2018), and more recently at the Caeira menhir (Rocha 2022). These uses are characterized by the standardized and repeated deposition of small vessels, usually carinated, in the space surrounding the menhirs, not necessarily still standing, but still understood as sacred spaces.

The reuse of several of these monuments (which incorporate both anthropomorphized representations and simple menhirs) in the construction of sacred landscapes during an apparently receding phase of the Bronze Age may have created a tradition of representation and materialization of mythical or real ancestors on stone that will come to mark more advanced moments of the Bronze Age in the southwest Iberian Peninsula. In reality, the data gathered from sites such as Arneiro dos Pinhais, Portela de Mogos, and São Sebastião (Mataloto 2018), interpreted as sacred spaces constituted next to ancient menhiric monuments, are somewhat in line with the proposal put forth long ago by Primitiva Bueno Ramírez (Bueno, Barroso Bermejo, and Balbín Behrmann 2011, 39) in which the compositions of the Bronze Age stelae were believed to have had their roots in ancestral references to megalithic traditions of representation. In the same sense, several Neolithic menhirs have been reused for "Extremeño" type stelae, such as São Martinho II, Cancho Roano, and Magacela (Celestíno Pérez 2001, 83; Díaz-Guardamino 2010, 371; Araque Gonzalez 2018, 191).

From the Neolithic to the Bronze Age, the Central Alentejo appears to have been closely linked to the creation and reuse of vertical standing stones conveying a sacred or heroic message, such as those associated with the stelae of the southwest Iberian Peninsula during later moments of this period. However, despite the strong roots of communities in the Final Bronze Age settlement networks described above, no stele of this type has been identified in the Central Alentejo region. Although it is tempting to characterize their absence as an epistemological illusion, it is important to keep in mind that this is one of the most intensely surveyed regions in the country. In the area near to the Central Alentejo, on the left bank of the Guadiana, the presence of "Extremeño" type stelae is well attested (Fig. 21); the Granja de Céspedes stele of the Badajoz area (Díaz-Guardamino 2010, 307), and a little further south, the Monte Blanco-Olivença stele (Díaz-Guardamino 2010, 322), positioned close to an important natural pathway.

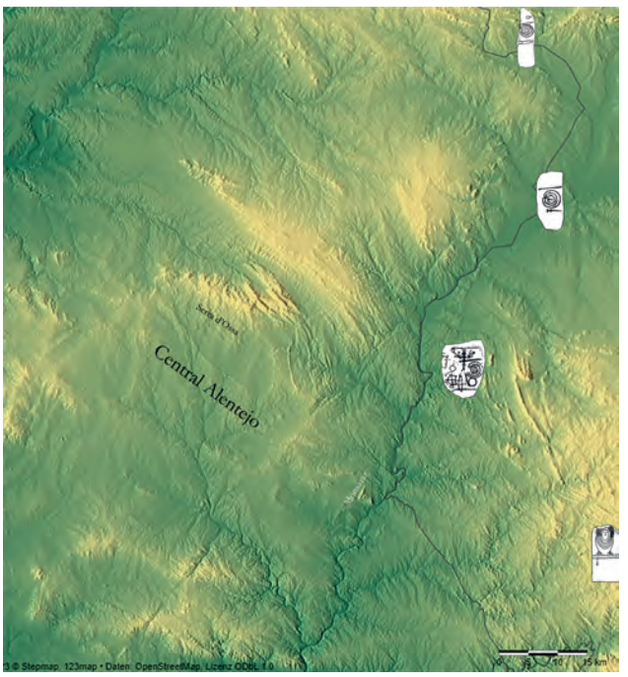


Figure 21. Final Bronze Age stelae from Extremadura, near the Guadiana river by Central Alentejo.

In the southern mountains of the province of Badajoz and north of Huelva, on the western limit of the Sierra Morena mountain range, there is a significant concentration of stelae; Capote, Bodonal, and the revealing case of Las Capellanías, in Cañaveral de Léon (Rivera Jiménez, *et al.* 2021). The scarcity of stelae in the currently Portuguese territory and their absence in the Central Alentejo is difficult to explain. This area may have assumed contours of cultural identity where these representations had no place, even in opposition to others further east, where these iconographic codes would constitute an important form of intergroup communication and identity in the landscape. The idea of a settlement network like that of Monsaraz, where the site of Molino de Porras appears to assume the river as a frontier space, allows us to question whether we are facing large, manifestly distinct cultural communities. Interestingly, in the settlement systems of the Final Bronze Age of the Serra da Adiça (Soares 2005), on the left bank of the Guadiana, these representations are unknown, standing in contrast to the area immediately to the east, in

Figure 22. Frame from Conan the Barbarian (1982) depicting The Battle of the Mounds. Here we can see the mounds and standing stones, a metaphor for the reuse of old megalithic monuments during the Bronze Age of the Central Alentejo.

the region of Fregenal de la Sierra. The megalithism of the Central Alentejo, frequently reincorporated into the construction of new ancestral landscapes during the Bronze Age, may have served as a differentiating factor, rendering the presence of stelae in the mythical construction of Final Bronze Age landscapes less relevant. The dolmens and menhirs would then return to being representations of a mythologized sacred space, where the Past merged with the Present, becoming arenas of identity aggregation for Bronze Age communities.

The title of this section is an excerpt from a part of *Conan the Barbarian* (1982) referred to as *The Battle of the Mounds* (Fig. 22). This scene takes place at a crucial moment in the film, set within a large megalithic complex where the hero seeks divine protection and proximity to the ancient gods– those same deities that emerging new religions sought to distort and challenge. In our opinion, it serves as a perfect cinematic metaphor for the process by which Bronze Age communities rooted their identity in ancient megalithic constructions, precisely at a time when images of warriorship and weaponry began to emerge and spread throughout the Iberian Peninsula.

Redondo, June 10th 2024

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CHAPTER 12

Tools and the Materials: Prehistoric stone-working techniques and the Iberian Stelae

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Abstract

The western Iberian stelae from the Final Bronze Age and Early Iron Age are highly distinguished rock art monuments that have been extensively studied regarding their iconography, typology, chronology, geographical distribution, and multifarious socio-cultural interpretations. Despite the many quotations of them as representative archaeological finds, technological, traceological, and material studies have only rarely been conducted. As a consequence, the actual tools and carving techniques have previously not been determined and the respective technologies have largely remained unexplained and unexplored. Hence, systematic studies of ancient stone-working techniques are still in their beginnings and remain a desideratum for archaeological research on rock art. In this chapter, the results from material analyses and archaeological experiments in order to assess the functionality of tools on the rocks used for the Iberian stelae will be presented and discussed. This approach provides new insights into the tool box of protohistoric Iberian craftspeople, and also holds surprises on the quality of then innovative materials, namely steel chisels.

Keywords: Rock art, Late Bronze Age, Early Iron Age, experimental archaeology, iron technology, chisel.

Resumen

Las estelas Ibéricas de la Edad del Bronce Final y de la Primera Edad del Hierro son monumentos de arte rupestre muy destacados que han sido estudiados en lo que respecta a su iconografía, tipología, cronología, distribución geográfica, así como a sus interpretaciones socioculturales. A pesar de las numerosas citas de los mismos como hallazgos arqueológicos representativos, sólo en contadas ocasiones se han realizado estudios tecnológicos, traceológicos y materiales. En consecuencia, hasta ahora no se han determinado las herramientas y técnicas de talla reales y las respectivas tecnologías han permanecido en gran medida inexplicadas e inexploradas. Los estudios sistemáticos de las antiguas técnicas de trabajo de la piedra siguen siendo un desiderátum para la investigación arqueológica del arte rupestre. En este capítulo se presentan y discuten los resultados de análisis de materiales y experimentos arqueológicos para evaluar la funcionalidad de las herramientas en las rocas utilizadas para las estelas ibéricas. Este enfoque aportó nuevos conocimientos sobre la caja de herramientas de los artesanos ibéricos protohistóricos y también proporcionó sorpresas sobre la calidad de los materiales entonces innovadores, concretamente los cinceles de acero.

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Palabras clave: Arte rupestre, Edad del Bronce Final, Primera edad de Hierro, arqueología experimental, tecnología del hierro, cincel.

1. Introduction

Hard rock materials, which have been commonly described as "granite" or "quartzite" in the bibliography, have frequently been used for sculpting the western Iberian stelae during the Final Bronze Age (FBA) to Early Iron Age (EIA) transition (1200-550 BC). This circumstance has been recognized as a significant technological challenge with important chronological and cultural ramifications in recent studies (Araque Gonzalez *et al.* 2023). Consequently, preliminary experimentations and discussions with professional stonemasons, geologists, and archaeometallurgists led to serious doubts whether particular hard rocks used for stelae could have been carved with bronze or lithic tools, or even with the supposedly soft iron that was available in Iberia during the FBA-EIA (cf. Renzi *et al.* 2013; Vilaça 2013).

Generally, the problems of stone working with prehistoric tools have rarely been approached. However, it must be taken into account that the creation of decorated stelae from hard rocks is by no means comparable to their counterparts made from softer rock types: as in modern stonemasonry, it must have involved fundamentally different tools and techniques. Eventually, the hypothesis that early Iberian iron technology might have encompassed the making of *hardenable* steel (Araque Gonzalez, 2018, 187) has been brought forward, based on the carving of the hardest rocks that can be used for sculpture, such as silicate quartz-arenites and quartzite.

Up until now, work traces and tool-marks have only been assessed macroscopically on a number of Iberian stelae in the museum of Badajoz (Enríquez and Fernández 2010), and on four stelae from Andalusia, where digital surface data had been recorded (Díaz-Guardamino *et al.* 2015). However, the focus of the latter study was on the detection of new motifs and possible palimpsests, and both analytic approaches have rather concentrated on a generalizing assessment of techniques (i.e. "pecking", "abrasion", etc.), instead of the evaluation of possible tools. Moreover, none of these studies involved an expert stonemason, neither have the significant differences in working with hard and soft rocks been taken into consideration. The important exception to this is a combined experimental and traceological study of the making of a stela with a schist rock and lithic as well as bronze tools (Gutiérrez Sáez *et al.* 2020). However, this approach does not allow for conclusions on the making of stelae from hard rocks, since the rock type that was used in their experiments is soft and offers entirely different working conditions if compared to granitic rocks or silicate quartz-arenites.

Experimental archaeologists working on rock art in the Tagus valley in Portugal (Santos da Rosa *et al.* 2014), in Scandinavia (Vourc'h 2011), and in Namibia (Breunig and Fels 2023) tried different lithic tools on often generically described sedimentary lithotypes (sandstone, schist and greywacke) that prevail in their study areas. Recent studies of the Glauberg statue from Germany (Trefný *et al.* 2022) focussed on traceology and the identification of tools from their marks and abrasion. Moreover, experimentations combined with Artificial Intelligence (AI) aided traceology in Russia aimed at distinguishing characteristic marks from lithic and metallic tools (Devlet 2012; Zotkina and Davydov 2022).

Due to the previous lack of traceological analysis and technological studies of the Iberian stelae, the present approach put emphasis on materials science (petrology and archaeometallurgy), complemented by experimental archaeology and traceology. For this case study, four stelae from the Museums of Badajoz, Baraçal, and Sabugal were fully or partially replicated with the same tools that were available to FBA-EIA craftspeople. Initially, the outcrops of those stelae which had been chosen for replication had to be identified with petrologic/geochemical analyses and geo-archaeological fieldwork (Ferreiro Mählmann *et al.* this volume). Thereafter, suitable slabs were obtained in the field and transported to the experimental workshops in Baraçal (Portugal) and Valverde de Burguillos (Spain), where the local communities greatly supported this research with logistics, workspaces, and accommodation. The experiment proceedings and results have been described elsewhere in detail (Araque Gonzalez *et al.*, 2025). Therefore, this contribution will concentrate on the FBA-EIA tools, their mechanical properties, and their efficiency on selected hard rocks used for the Iberian stelae.

2. Methods

2.1 The experimental setup

Within this combined approach, the stelae from Baraçal 2 and Fóios, both in the area of Sabugal (Beira Interior, Portugal), as well as two stelae from Capilla (Extremadura, Spain) were replicated. Initially, the provenance of the original rocks was determined and slabs for the replications were acquired from the outcrops. Secondly, the possible stone-working tools that were available from the FBA onwards have been assessed from the archaeological records and in the local museums in Portugal and Spain. The most probable candidates amongst lithic tools, bronze chisels, and one iron chisel were analysed with petrography, respectively with metallography, and the bronze alloy compositions with pXRF. Subsequently, tools such as chisels,

choppers and adzes were replicated according to scientific standards. The set of replicated tools was tried by stonemason Giuseppe Vintrici, who had training in ancient historical techniques and previous experience in experimental archaeology. First, their effectiveness and handling were tested, then the most efficient implements were used to carve the same designs that were found on the monuments. The experimental protocol included the following work-steps:

1. Preparation of the slab and its surface (if applied on the originals);
2. Testing of tools to determine efficiency;
3. Carving of the motives;
4. Documentation of results (photography, photogrammetry, 3D-scanning);
5. Donation of the finished duplicates to the local museums or municipalities.

It was anticipated that robust tools, preferably with a softer shaft, which could absorb the shock of hammering, and with wedge-shaped blades that hold a high degree of sharpening, would provide the best results. Chisels were already made from copper in the Chalcolithic and are wedged, elongated, edged or pointed cutting tools that usually consist of a shaft, which is left in a soft state in order to absorb the shock of strikes, and a sharp blade or point that is ideally hard enough to cut into materials and retain its cutting edge. Therefore, in the case of metal chisels, the edge would be hardened, which means heat treatments, quenching, and hammering for bronze and the latter two steps in reverse order for iron. Chisels are typically used with a mallet or hammer and create impact through indirect strikes, while more massive firmer chisels can be used to carve and incise directly and hand-held.

The use with indirect strikes, either with a hard-wood or metal (bronze or iron) mallet or hammer is the most established technique for stone-working chisels. Although chisels have been made since the Neolithic from lithic and organic materials, for example silex, bone, and antler, the basic classic chisel shape occurred directly with the introduction of metallurgy in the Chalcolithic and remained unchanged until this day. The main variety is the size, and best for precise their use is slightly larger than the sculptors palm, or ca. 12-15 cm. Firmer chisels that can also be used with both hands are often significantly longer but usually preferable for working with softer materials, especially wood. Furthermore, sharpened axes and choppers were also taken into consideration as tools for rock art. It was a precondition for such predominantly lithic tools that they are not too brittle, which would cause them to break soon under repeated impact and shearing. One most important aspect for creating rock engravings is the rule: the sharper the tool, the easier to break in between the grains of the rock microstructure, in order to create a precise line.

2.2 The rocks

The three rock types presented in the following section were the basic materials that had to be carved with the replicated tools (Tab. 1). Each one of them stands representative for numerous stelae of similar lithologies. The rocks as well as all outcrops have been determined with petrologic methods (see Ferreiro Mählmann *et al.* this volume). Another criterion to assure their technical comparability with the originals was the possibility to acquire suitable sized slabs from the same outcrops where the rocks for the FBA-EIA stelae had been sourced.

Particular sedimentary lithotypes that offer favourable technical conditions to create marks and carve symbols with lithic or metallic tools have attracted the interest of prehistoric communities worldwide, for example in Scandinavia, the Alps, Asia, and south America. Less frequently, granitoid and gneiss rocks have been worked and carved for the same purposes and probably with similar tools, for example in Iberia (Gonzalez Bornay and Domínguez García 2021) or Corsica (Leandri, Peche-Quilichini, and Cesari 2019, 36–37). However, extremely hard silicate quartz-arenites ("quartzite") have not been used for sculpture anywhere in Europe and the Mediterranean regions until the 14th century BC in Egypt, for example for statues of gods and pharaohs (cf. Aston, Harrell, and Shaw 2000, 53–54), and around the beginning of the 1st millennium BC for a group of Iberian stelae in the Zújar and Guadiana valleys in Extremadura. It must be noted that the term "quartzite" is used in Egyptology for "siliceous sandstone", and therefore refers to the same silicate quartz-arenites that were used for these particular Iberian stelae. Metamorphic quartzite has not been used for sculpture neither in Ancient Egypt (Aston, Harrell, and Shaw 2000, 53), nor to current knowledge in Iberia.

Leucocratic syenogranite aplite (granite aplite), a magmatic rock from the Beira Interior

In order to replicate the stela of Baraçal 2 (Santos, Vilaça, and Marques 2011), the leucocratic (very light coloured) muscovite-syenogranite aplite from the Lajeiras quarry has been used, which corresponds to the original monument's rock. Its technical properties comprise a fine-grained isotropic mineral composition, uniform grain size, non-porphyry feldspar, and a relatively low mica content (>15%), which constitute an excellent material for sculpting because they allow for the carving of precise lines without greater danger of fringe outbreaks. In order to do so, the surface had to be prepared by removing the weathered upper crust and by fine polishing

Table 1: Petrographic overview of lithotypes used for FBA-EIA stelae replications and for the tool testing experiment. The Mohs hardness of constituting main minerals is indicated, according to the Mohs scale from 1 (talc) to 10 (diamond). The sample number (Po = Portugal, Es = Spain) is indicated for cross-referencing with Table 1 and 2 in Chapter 11 (this volume).

Rock	Object	Outcrop	Quartz (Mohs 7) Vol %	Feldspar (Mohs 6) Vol %	Mica (Mohs 2-3) Vol%	Other minerals Vol%	Surface Prep.	Comments
Leucotratic Syenogranite aplite	Stela Baraçal 2 (Po 30)	Barrocal 2 (Es 12) &Lajeiras (Po 13)	34	52	14 (muscovite)	0	Levelling and polishing	Large slab, transport challenging (ca. 667 kg)
Meta-sub arkoses	Stela Fóios (Po 25)	Cabeço do Pisão (Po 24)	48	21	31 sheet silicates	0	Not required	Hard ground, small slab (ca. 76 kg)
Silicate quartz-arenite	Stela Capilla I (Es 23) Capilla VIII (Es 27)	Sierra de la Moraleja (Es 10 & Es 14)	98	1	0	1 heavy minerals	Not required	Hard ground, replications on smaller slabs than original stelae
Magnetite-actinolite skarn	Tool (Po 20)	n/a	5	0	0	76 actinolite / tremolite 10 magnetite 9 others	Grinding (angle grinder)	Found in Barrocal quarry
Magnetite, titanite-actinolite skarn	Tool (Po 23)	n/a	7	0	0	58 actinolite / tremolite 18 titanite 7 magnetite 10 others	Grinding (angle grinder)	River Côa, near Baraçal
Diablastic quartzite	Tool (Po 22)	n/a	>99%	<1%	traces	n/a	Grinding (angle grinder)	Found in Lajeiras quarry

Figure 1. A. Stela from Baraçal 2 (Po 30) (Foto: Ángel Felicísimo, KRAKEN). B. Drawing of motifs; the pecking over the motifs is a recent damage (after Santos et al. 2011, 339, Est. 3); C. Replication with rock from the Lajeiras syenogranite aplite (Po 13) (Foto: G. Vintrici).

Figure 2. A. Stela from Fóios (Po 25) (Foto: M. Kaiser). B. Replication with a meta-sub-arkoses rock (Po 24) (Foto: R. Araque).

the fresh rock material. Furthermore, the physical composition of this rock is representative for most of the granite stelae that have been analysed within this study. The decorations represent a characteristic motif composition with a central v-notched shield, a sword and a spear pointing in opposite directions, a mirror, and rests of a helmet, all of which have been replicated at a 1:1 scale (Fig. 1).

Meta-sub arkoses, a metamorphic rock from the Côa river

The stela of Fóios (Osório 2005) was carved into a slab of dark grey meta-sub arkoses with a reddish hard ground surface (lithified under oxidizing conditions), which is predestined for carving without the need for surface preparation. The sedimentary and meta-sedimentary rock outcrops stretching max. 4 km along the Cabeço do Pisão ford across the river Côa, near the village of Fóios, provide plenty of plates that can be used for stelae-making. For the experimental replication, a slab of analogous lithology was acquired from these outcrops.

The technical properties of this rock type correspond to several sedimentary and meta-sedimentary stelae that have been assessed within this study. The hard ground was apparently a much sought-after feature, because it facilitated the carving by providing a colour contrast with the lighter underlying layers, which are revealed by its removal. The design of Fóios shows a basic motif composition with a sword and a spear pointing opposite and a central v-notched shield as well as a possible rest of a fibula and has been replicated at a 1:1 scale (Fig. 2).

Silicate quartz-arenite, a sedimentary rock from the Zújar valley

The mesoscopic analyses of stelae in the Museum of Badajoz have shown that several specimens are made from extremely hard silicate quartz-arenite with a mono-mineral composition (>95% quartz) and diagenetic transformation. These rocks are amongst the hardest that can be used for sculpture and share most physical properties with non-foliated metamorphic quartzite, although the isotropic silicate quartz-arenite favours the carving of precise lines without random outbreaks. The outcrops in the Sierra de Moraleja above the Zújar basin provided slabs with a corresponding lithology (Araque Gonzalez *et al.* 2023).

In all cases, the motifs were carved into a red-bedded hard ground surface, providing a contrast that highlights the ornaments; hence, surface preparation was not required. The stela of Capilla I (La Moraleja), shows an anthropomorphic figure with diverse ornaments and a possible headdress; the motives had to be downscaled to 75% due to a smaller slab size. On a second, river-rounded slab, selected warrior motifs from the stela of Capilla VIII (La Pimienta) were replicated free-handed and unscaled (Fig. 3).

2.3 Individual materials: challenges of comparing hardness measurements

Due to the nature of the involved materials, especially when it comes to comparing metal and lithic tools, there are major difficulties that obstruct a simplified comparison

Figure 3. A. Stela from Capilla I, La Moraleja (Es 23) (Foto: Ángel Felicísimo, KRAKEN). B. Replication with silicate quartz-arenite from the Sierra de la Moraleja (Es 14) (Foto: R. Araque Gonzalez).

of hardness values, and could thus facilitate the identification of efficient materials. Mineral hardness is commonly measured on the Mohs hardness scale between 1 and 10, which refers to their scratching hardness. Moreover, the Mohs value only indicates the hardness of a homogenous mineral, but not of a rock that is composed of diverse minerals.

Metals are conveniently tested by archaeometallurgists with the Vickers method (delivering a HV value after impressing a diamond pyramid) and by the industries with the Brinell method (delivering a HBW value after indenting a tungsten carbide ball), measuring their resistance to plastic deformation. Therefore, the Mohs hardness cannot be set in a meaningful correlation with the Vickers and Brinell hardness. Both latter values for metals are most useful for evaluating tools and can be correlated to each other. However, HV values of the refined steel that was used from the Late Bronze Age to the end of the Middle Ages are not representative for the whole implement and only characterise the tested spot, because the carbon content often differs significantly within the same piece. Several values must be taken to be indicative for the overall quality, ideally on working edges and other parts that are expected to be hardened. Indeed, the HV value of steel with a known carbon content can be indicative for hardening if it surpasses the known values of comparable modern steel. For example, one welded sheet of an iron knife blade from the FBA site of Moreirinha in Portugal (Vilaça 2013) with a recorded carbon content of ca. 0.4 wt% delivered a value of 250 HV (Renzi *et al.* 2013) and hence appears to be hardened, because quenched and tempered modern C45 steel (C 0.42-0.50 wt%) has a value of 255 HBW, corresponding to 262 HV.

Moreover, the microstructures of both the tool and the rock to be carved play a significant role. For example, a sandstone with a high quartz content (Mohs hardness 7) can still be soft if the grains are embedded in clay minerals, but might become extremely hard once silification, diagen-

esis or metamorphism (transformations under pressure and high temperature conditions) are present. In addition, the degree of intergrowth, cohesion and foliation, amongst other factors, determines how resistant a rock microstructure is against carving attempts. Lithic tools with less or equal Mohs hardness can roughly carve rocks of the same mineral composition and hardness if the shear strength and the compressive resistance is higher and the abrasion lower due to their microstructure. The same applies for metal tools, which only reach a high level of impact strength and shear strength when they undergo heat treatments and cold or hot hammering, which transform their microstructure. Conversely, a metal blade might scratch a rock superficially but deform quickly and become useless as soon as it is used with impact. These physical conditions and variables make the experimental trials of tools imperative, which must be performed before any preliminary conclusion on their efficiency is acceptable.

3. Tools and their performance

3.1 Lithic tools

Lithic tools were most frequently used for rock art that involved carving and incision techniques during prehistory. Before the introduction of metal tools, they represented the only materials that were at the same time hard enough to scratch and break most rock types and could be sharpened in order to obtain a certain degree of precision for the decorative lines or reliefs. It must be mentioned that softer rocks could also be worked with antler or bone tools, however these material have their limitations as soon as the microstructure becomes denser and the surfaces become harder to break.

For this study, five locally available materials used for lithic tools from Portugal and two from Spain were sampled for petrographic analyses. In the following paragraphs, the most efficient replicated lithic tools and the results from their performances on the above mentioned rocks will be discussed. Other lithic tools have been replicated according to the artefacts in the local museums, however some materials have proven inefficient for sculpting. The discarded materials included vein quartz and silex (too brittle), meta-psammites/arenites and diverse amphibolite river pebbles.

Quartzite adzes and choppers

The above mentioned experimental archaeological studies have unequivocally concluded that quartzite is the most suitable lithic material for stone-working tools; vein quartz as well as silex and chert have been found to be too brittle and splinter even upon comparatively soft rocks (Breunig and Fels 2023; Santos da Rosa *et al.* 2014; Vourc'h 2011). Accordingly, quartzite pebble tools (made with interlobate to amoeboid bulged recrystallized quartz-arenites, or meta-quartzites) have been included in the experiments performed for this study. Adzes, hammers and choppers were replicated in collaboration with experimental archaeologist M. J. Kaiser (Fig. 4). These implements were efficient for the rough working of the aplite, however, when carving lines into the polished surface, they splintered and blunted rapidly (1-5 min.).

Since the wear and tear demands re-shafting after very short periods, which is time consuming, especially when done with raw hide bindings that were the only strong enough fixing to withstand the stone hammering process. The quartzite pebble choppers were also tried with direct strokes, with a similarly bad result of quick blunting and splintering on granite aplite. They would have been deposed of quickly, which would have been ineffective, wasteful, and should have created a considerable amount of debris at the workplace. These appear to be critical arguments against their use for the carving of granitoids. On the other hand, they were good to use for carvings in the meta-sub arkoses, but splintered immediately when used on the silicate quartz-arenite and can be discarded for working this material.

Diablastic quartzite choppers

During the survey of the abandoned quarry of the Lajeiras aplite, which had been mined until the last century, stonemason G. Vintrici found a yellowish, very compact piece of contact metamorphic, diablastic (intergrown) quartzite without a foliation (Fig. 5). This rock did not originate naturally in the surrounding area, indicating that it had been brought from further afield. The artisan considered it a robust tool worth trying, hence it was sharpened with the angle grinder and used with remarkable success on granite aplite and meta-sub arkoses. Notably, a very similar quartzite was found by the same stonemason in the Sierra de la Moraleja, next to the silicate quartz-arenite outcrops that were used for stelae. Again, the quartzite must have been brought to the site from elsewhere since there is no local outcrop, however it is in both cases impossible to determine when and in what circumstances they got to these places and none of both showed signs of being worked into a tool.

The diablastic quartzite was subsequently used on the experimental silicate quartz-arenite stelae, showing that with constant and strenuous pecking, the hard ground surface could be broken to create a colour contrast. However, the quick blunting and imprecision render it highly im-

Figure 4. Quartzite adzes and hammer and exemplary set for manufacture with raw hide binding; other forms of binding, for example leather, have proven inefficient for stone-working tools in this experiment because they loosened quickly (Fotos and replications: Michael J. Kaiser, Freiburg).

probable as a tool for most of these stelae. In summary, the diablastic quartzite resulted to be the best lithic tool for rock carving, however it has to be kept in mind that any tool has to be maintained sharp to be efficient, and the re-sharpening of these compact quartzite tools would have significantly reduced their usefulness. The average time until re-sharpening was measured at 7-10 min. on granite aplite, and at ca. 1 min on silicate quartz-arenite.

Polished actinolite skarn tools

Stonemason G. Vintrici found a small stone wedge in the abandoned quarry of the Barrocal aplite, which resulted to be an actinolite skarn that must have been brought to the site from the Côa river at a few kilometres distance. This material was used for polished axes and other tools since the Neolithic. This find was sharpened with the angle grinder and used as a shafted tool (axe and adze) as well as for direct pecking. Most interestingly, the accompanying archaeologists and geologists alike tried to convince the stonemason that this material is not worth trying on granitic rocks because it would be too soft. However, the fibroblastic and diablastic grain microstructure of the actinolite skarn causes a toughness that makes the tool resistant to pressure, specifically its uniaxial compressive strength (Fig. 6).

Therefore, it was possible to use it for carving lines into the granite aplite surface, at least for a short duration before needing to re-sharpen (average measured at 5 min.). The skarn worked excellently for the meta-sub arkoses, where the ratio of work time and re-sharpening was reasonable. In summary, the actinolite skarn is a good material for making polished blades that can be used in the carving of softer stones, however the rapid abrasion forces constant re-sharpening and makes the use on granitic rocks painstaking. Indirect strokes with a hammer would have been inappropriate with this tool due to its brittleness. Nonetheless, a small polished blade could theoretically be shafted in wood to be used as a chisel with a mallet, although the risk of breaking quickly would be considerable. Finally, it could not break the surface of a silicate quartz-arenite.

Chalcedony, sillimanite quartzite, chert

Local chalcedony from an outcrop near Baraçal was tried only on the last day of the experiment for a short line in granite aplite and delivered promising results. The chalcedony engraved proper lines and was easy to re-sharpen by

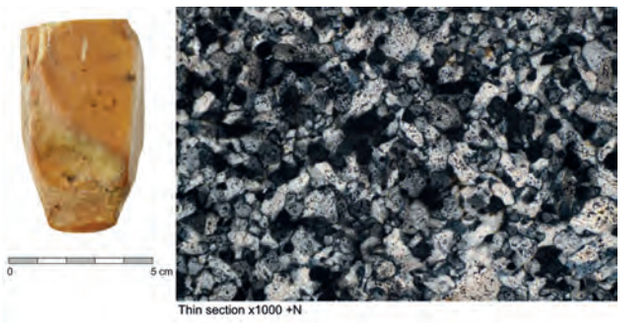

Figure 5. A. Quartzite tool (Po 22) (Foto: M. Kinsky). B. Diablastic microstructure (Microphotograph: R. Ferreiro Mählmann).

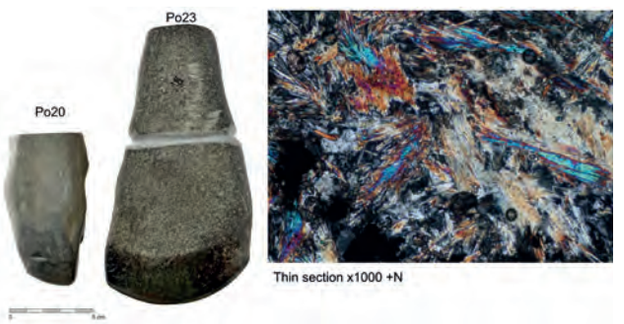

Figure 6. A. Actinolite skarn tools (Po 20 and Po 23) (Foto: M. Kinsky). B. Fibroblastic, diablastic microstructure of Po 20 (Microphotograph: R. Ferreiro Mählmann).

chopping it back into shape, however its brittleness caused quick wear and the debris would have been considerable. Finally, after the experimentation, a half-hand sized, round pebble of contact metamorphic quartzite composition with a polygonal-inter-lobate quartz matrix, intermingled with fibroblastic sillimanite (fibrolite) was found close to the findspot of the stela of Aldeia Velha. This microstructure provides a much higher toughness, shear strength, and impact strength than other lithic tools. This material, which is also represented by several skilfully polished, so-called miniature axes that date from the Neolithic into the FBA (Vilaça, Osório and Catarino 2023), should be tested for carving granitic rocks in a follow-up experiment. The small blades might have been shafted in a softer material, such as wood or antler, to provide a good shock absorption when used with a hammer or mallet. However, sillimanite quartzite is not considered to be efficient on the much harder silicate quartz-arenites due to its remaining brittleness.

Belgian chert, which has a similar hardness to quartzite but is easier to re-sharpen, was used on the aplite replica and first appeared to be capable of carving lines, however the brittleness rendered it useless after a short time and the retouch resulted in unproportioned wear and tear. Due to the unavailability of corresponding material in the Beira and the lack of known imports in prehistoric contexts, the material was discarded as a probable tool.

3.2 Bronze chisels

Sebastian Celestino was the first scholar who dedicated a few lines to the material properties of the rocks used for stelae and the possible problems of working them, however he formerly believed that the monuments, including the quartzite ones, were made with chisels "*lógicalmente de bronce*" (Celestino Pérez 2001, 87). Archaeometallurgical analyses of FBA-EIA bronze chisels from Portugal, seven of which have been conducted for this study, have shown that the binary alloys often had a high tin content (12-16%) and that the edges of chisels underwent hardening techniques, which involved heating to the red hot state, quenching and the subsequent cold hammering for bronze (cf. Bottaini 2012). In summary, all analysed bronze chisels revealed that they were made for heavy duty use and the blade was intentionally hardened to provide an optimized performance.

The massive chisel from Freixianda with an alloy of 14-16% tin, with HV measurements ranging from 229-265 (Vilaça, Bottaini, and Montero Ruíz 2012), served as a prototype for the experimental replications (Fig. 7 A). However, its size points towards a firmer chisel and is rather unhandy (although still suitable) for using it with a hammer, and smaller specimens would have done the job. Chisel replications were cast with binary bronze alloys containing 10, 12, 14 and 16% tin (Fig. 7 B). The bronze chisels were sharpened, hardened (measured HV0.5 at 225, 316, 324 and 285), and used with a mallet made from yew wood (Fig. 8). One mistake that has to be admitted here is that the massive size was considered to be the best suitable for stone working. Eventually, there was little faith in the efficiency of bronze for the carving of granitoids or silicate quartz-arenites.

Indeed, the granite aplite could only be rid of its soft, weathered upper crust and worked by levelling bumps and knocking off edges with the bronze alloys of 14 and 16%, which resulted in their deformation and fissures in the chisel blades. The carving of lines in the polished surface of the chosen granite aplite was not possible with any alloy. A humble result could be achieved with the 14-16% alloys on the meta-sub arkoses, where some areas (those with a lower quartz content) could be carved, although the heterogeneous nature of the rock rendered the bronze tools inefficient and they blunted after 3-5 minutes. On the other hand, the incision of previously pecked lines in the latter rock was possible with the sharp edges of the chisels and created equalized, v-shaped profiles.

Neither bronze alloy could break the hard ground of the silicate quartz-arenites and they could be discarded for carving this material. The harder chisels with binary alloys

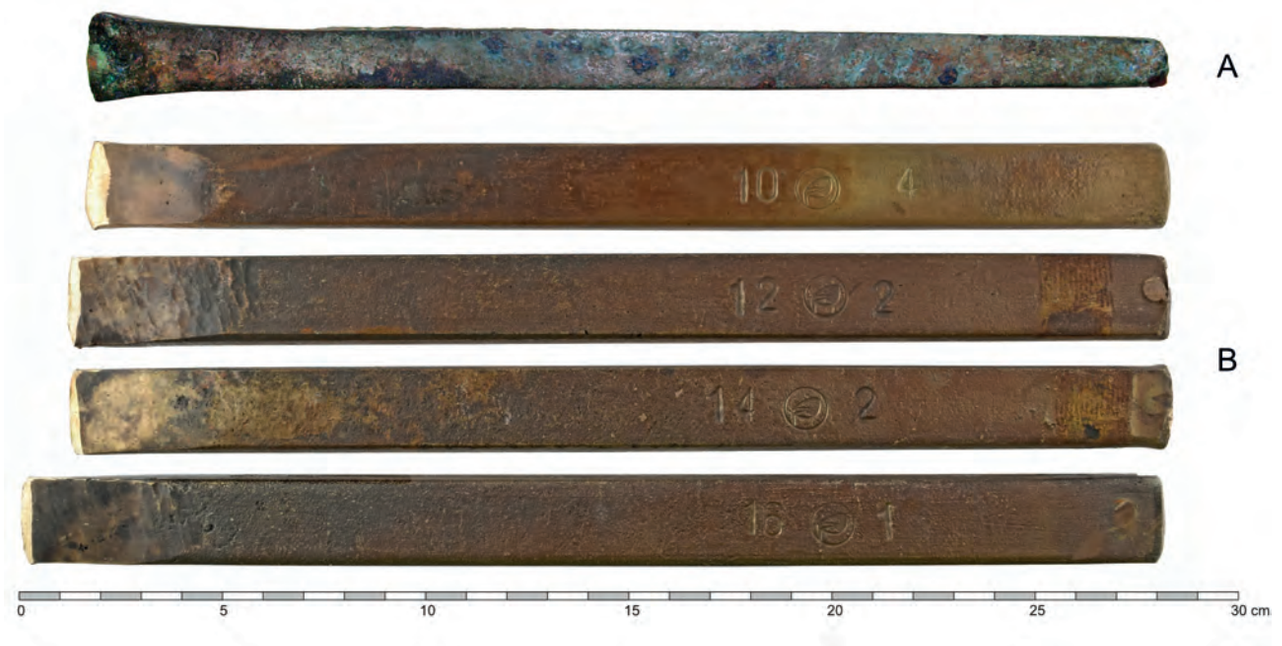

Figure 7. A. Chisel from the Freixianda-hoard, Portugal (courtesy of R. Vilaça). B. Bronze chisel replications with 10, 12, 14 and 16% tin alloys by Bastian Asmus, Labor für Archäometallurgie, Kenzingen (Foto: M. Kinsky).

Figure 8: Use of bronze chisel with a yew wood mallet (Foto: R. Araque).

of 14% and 16% tin splintered under repeated strikes, due to the work hardening of copper based alloys. Contrary to ferrous metal alloys (such as for example carbon steel), the hardening effect in copper alloys is due to plastic deformation of the crystal structure, and not due to a change of the crystal lattice. Therefore, when the applied forces exceed the tensile strength of the alloy, the plastic deformation of the grain structure will ultimately lead to the failure of the material. This could be observed within the experiments and can be regarded as one reason for the adaption of iron tools and their preference over bronze in later prehistory.

3.3 Refined Steel

Several iron artefacts from the FBA, predominantly small knives and saw blades as well as several chisels, have been documented in Iberia, some of them dating as early as the 12th-11th century BC (Almagro-Gorbea 1993; Jambon *et al.* 2023; Vilaça 2013). Following the observation that hard rocks, especially "quartzites" would be extremely challenging to carve with any tools available before the introduction of hardenable steel (Araque 2018, 187), metallographic analyses of an iron chisel from the FBA hamlet of Rocha do Vigio in the Guadiana valley in Portugal were conducted (Fig. 9 A). The surprisingly well-preserved iron tool was found together with two square tuyères similar to the ones that were used for iron smelting in the Levant from the 10th century BC onwards (Veldhuijzen and Rehren 2007), and a mould for casting bronze chisels, in a context that could be Radiocarbon dated to 900-770 cal. BC (Calado *et al.* 2007; see Mataloto, this volume).

The metallographic study of the chisel (Araque *et al.* 2023) revealed a typically heterogenous steel from a refined bloom with folded and welded heterogeneous layers of ferritic iron and steel (see Mink, this volume), with an overall medium-high carbon content (up to 0.77 wt%), and was therefore hardenable (see Asmus, this volume). However, the exact replication of a similar heterogeneous steel constituted a major logistic problem. Consequently, the participating archaeometallurgist and blacksmith A. Richter decided to use the technically best comparable modern C60 steel with a standardized carbon content of 0.57-0.62 wt% C for our experimentation (Araque *et al.* 2023). Four chisel replications

Figure 9. A. Chisel from Rocha do Vigio (Foto: R. Araque). B. Hardened, quenched and tempered C60 steel chisel replications by Alexander Richter, Fragua Fuirio, Seville. C. Unhardened, soft annealed C60 steel chisel replication with deformed blade after use on silicate quartz arenite (Fotos: M. Kinsky).

were forged by blacksmith Alexander Richter (Fig. 9 B), three of which were hardened from a cherry red state (ca. 800°-850° C), quenched in water, and tempered in the forge at ca. 260° C resulting in a hardness HV0.5 between 736-831; one chisel was left in the soft state for comparison (Fig. 9 C). Only the blades of the chisels (along ca. 5-10 mm) were hardened, while the shafts had to remain in a soft state to avoid brittleness and splintering. All four chisels were sharpened and used with a club hammer and a yew wood mallet.

This discovery was a game changer for carving the silicate quartz arenite, since the hardened steel chisels were the only tools that were capable of carving precise lines into this rock. However, even the C60 steel, which would certainly not be used for modern chisels, blunted quickly and needed re-sharpening after 5 minutes on average. As a consequence, they had to be re-hardened after the constant abrasion exceeded the originally prepared edge. Accordingly, the hardening process, which encompassed the knowledge of incandescence colours (cf. Baptista *et al.* 2023; Bergland 2019, 59), must have been known to FBA-EIA artisans. The unhardened C60 steel was tested on the same rock and could not carve proper lines, besides blunting within seconds. The maximum effect was similar to the surface breaking that was achieved with the diablastic quartzite chopper, however less frayed on the fringes (see Araque *et al.* 2023). The reason for this is the significant increase of hardness from the soft annealed (modern standardized C60: HV 195) to a quenched and tempered steel (C60: HV 340-530)[8]. Hardened carbon steel is very hard, but brittle, and is not directly usable for impact tools in this state. The stresses introduced into the crystal lattice during its formation need to be released by the process of tempering. Tempering increases toughness and decreases the hardness. The higher the tempering temperature, the better the toughness and the lower is the resulting hardness. The temperature during tempering can also be deduced from the colour of the hot metal (see Baptista *et al.* 2023, 437; Bergland 2019, 62). Finally, thus far, the steel chisels have not been tried on granitic rocks and meta-sub-arkoses since at the time of the first experiments they had not been replicated, because the unexpected quality of the FBA steel was still unknown.

4. Results

4.1 Carving granite aplite

The polished surface is the first striking feature of all Iberian FBA-EIA stelae that were made from granitoid rocks, without exception. On Baraçal 1, the only stela in bas-relief, the decorated front had been polished before levelling the surface around the raised motifs. This type of surface treatment is outstanding, since only few non-granitic stelae were polished or had another all-round processing beyond being hewn in shape. The polishing of the granite surface until it is smooth and even is an important prerequisite for the engraving. This surface treatment provides a contrast to the fine indentations, which would not be visible on a rough surface. Moreover, it was necessary to level the naturally uneven surface structure of the fresh rock after

[8] http://www.steelnumber.com/en/steel_composition_eu.php?name_id=353

knocking off the weathering crust and rough hewing. The experiments have shown that up to this work step, tools for hammering, such as quartzite and even compact vein quartz adzes, choppers and mallets as well as bronze chisels with 14-16% tin alloys could be used. However, the high degree of wear of the bronzes indicates that this would have been a seemingly non-economic choice.

Once the fresh and bright rock surface is exposed, it had to be polished with fine and coarse quartz sand, water, and a grinding stone, for which finer as well as coarser pieces of granites were used in the experiment. This process could be calculated to take around 200 working hours for a stela of the size of Baraçal 2 (measuring 190 x 64 x 24 cm), which could comfortably have been accomplished by up to four people simultaneously grinding the surface (for a full account, see Araque González *et al.*, 2025). Eventually, it became perfectly clear during the experiment that the carving of light-coloured syenogranite must be carried out in good lightning conditions, preferably in the sun. Amongst German speaking stone masons, *"Das ist im Schatten gemacht"* («this was made in the shade») is synonymous for an unsuccessful work (pers. Comm. G. Vintrici).

The finishing of the stelae began with the carving of the motives, which could be measured out and sketched, or directly copied from original objects, such as the swords and shields. A sharp quartz crystal was perfect for a first incision of the design. Subsequently, the motifs can be carved with lithic tools, such as the diablastic quartzite, or with a polished actinolite skarn blade. Polished sillimanite quartz and chipped chalcedony blades might also have been used wherever these materials were available. However, the critical point for lithic tools is the need for constant re-sharpening of the lithic tools which might constitute a disproportionate ratio of engraving to sharpening, and this appears to be problematic.

Bronze chisels that were replicated for the experiment could not carve lines into the polished granite aplite; those chisels with harder alloys (14-16 % Sn) broke due to their brittleness, and the softer specimens (10-12 % Sn) bent or were flattened within seconds. Refined bloomery steel or a modern equivalent material have not been tried on granitic rocks to this date. In summary, the results are informative for granite working with prehistoric tools, however until steel chisels have been tested on similar rocks and traceological analyses provide further insights, they remain inconclusive for this material.

4.2 Carving meta-sub arkoses

The sedimentary and meta-sedimentary rocks that were analysed for this project mainly represented arkoses, siltstone, greywacke (arenite, lithic arenite) and meta-greywacke psammites (see Ferreiro Mählmann *et al.*, this volume; Merino-Martínez *et al.* 2019). These rocks can have the most heterogenous compositions in one and the same slab, especially when areas with fine quartz veins and segregations provide a higher hardness than the surroundings. Nevertheless, most rocks from this group are softer and hence easier to work than fine-grained granitoids or silicate quartz-arenites. Surface preparation is usually not required for all rocks with a hard ground, however some irregularly breaking or river-rounded arkoses had to be pecked and rough-hammered to obtain an even surface (for example on two stelae from Zebros in Portugal), and a few might also have been polished.

For this experimentation, the meta-sub arkoses from the Fóios outcrop (Po24) was carved, and the diablastic quartzite chopper as well as the actinolite skarn blade worked very well. The requirement for re-sharpening of the lithic tools was considerably less frequent if compared to the granite aplite. The actinolite skarn worked 15-20 minutes on average, and the diablastic quartzite kept its edge much longer. Bronze chisels with harder alloys (14-16 % Sn) could be used to carve lines in the softer parts, however they blunted rapidly (<5 min.) and, most inconveniently, showed horizontal fissures on the blade once they were used on the quartz-rich parts of the slab. Interestingly, this rock could very well be scratched and incised after the surface was broken by pecking, which is due to the recrystallized clay mineral matrix in which the quartz is embedded. The hard ground surface itself, on the other hand, is component supported and almost without matrix. The pecking followed by incision created precise, regular lines with v-shaped profiles. This combination of techniques is also evident on the original Fóios stela, however, only some lines or parts of lines have been incised (Fig. 10). The process could be done either with the wedge-shaped blade of a lithic tool, or with any of the bronze chisels that were used (10-16% Sn), which indicates that breaking the surface was the gravest task for the tools and the different hardness was tricky because it could cause sudden breakage.

4.3 Carving silicate quartz-arenite

The stelae from Capilla I and Capilla VIII, both made from extremely hard silicate quartz-arenite, were replicated in a second experiment (Araque Gonzalez *et al.* 2023; 2025). Similar to several other stelae from Extremadura, they are decorated with mostly well defined, u- and v-shaped lines, which have such precise edges that they must have been created with a proper sharp tool (Fig. 11). Initially, the quartzite, diablastic quartzite, bronze and steel tools were tried to engrave a straight line into the silicate quartz-arenite; actinolite skarn was discarded after an un-

Figure 10. Details of lines from the Fóios stela with sidelight, showing diverse carving techniques (Fotos: M. J. Kaiser).

successful pre-trial. The quartzite pebble chopper was used as an adze-hammer and splintered within seconds, only slightly and irregularly scratching the surface.

It could be observed that the hard ground surface could be superficially broken with the diablastic quartzite chopper, however the trace was irregular, the impact low and precise lines were impossible to carve. Moreover, after less than 5 minutes and creating a frayed, 2 cm long carving, the tool was completely blunt. After pecking for 20 minutes (2 x 10 minutes, because of re-sharpening and to reduce strain on the wrist), the result was similar to the figure and an «erased» motif on the stelae of Zarza Capilla I and II, and reminiscent of lines on the stela from Belalcazár (Fig. 12). Therefore, it can be concluded that some alterations as well as one or two stelae designs could have been made with a similar tool. However, a blunt or poorly hardened iron may produce marks with similar or at best slightly less frayed edges. In an additional experimentation, very hard chert from the Madrid area was used on a silicate quartz arenite and created similar marks as the diablastic quartzite, however with high wear and tear and rapid blunting.

None of the bronzes could penetrate the surface of the quartz-arenites, the only traces left by these tools were the bronze abrasion on the hard-ground. Eventually, only the hardened, quenched and tempered steel chisel could provide the same precision and create comparable lines to the carvings of the replicated silicate quartz arenite stelae from Capilla. There are no experimental findings of lithic or bronze tools creating similar impact profiles on silicate quartz arenites (Araque Gonzalez et al. 2025). Therefore, it must be concluded at this stage of research that the well-worked stelae from this rock type, which are concentrated in the Zújar and in its close vicinity spreading into the Guadiana valley (see both Paniego and Ferreiro Mählmann *et al.*, this volume) have been carved with sharp, hardened steel chisels.

5. Summary

The experimentation demonstrated that bronze alloys with 10-16% tin could neither break the silicate quartz-arenite surfaces nor were they useful to carve polished granite aplite. However, they worked reasonably on the meta-sub arkoses, unless invisible quartz-concentrations in the rock structure were hit. Based on the experiment findings, it seems plausible that bronze chisels were normally used for softer rocks, or for the rough working of granitoids as opposed to sculpture and carving, or as firmer chisels for wood and organic materials.

However, while granitic rocks cannot be worked into stelae with bronze, lithic tools made from diablastic quartzite and, with a *caveat* due to the intense wear and tear, ac-

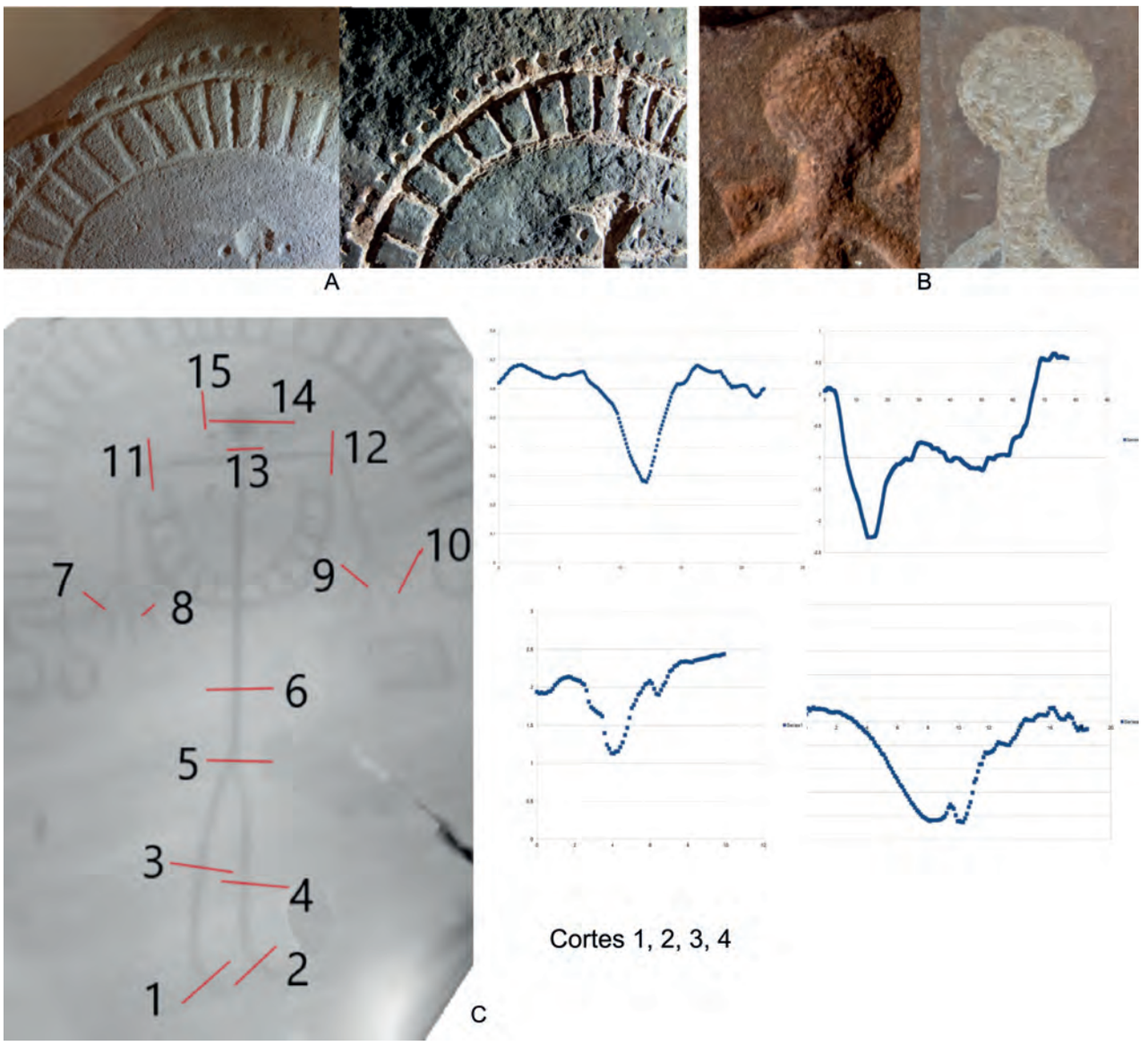

Figure 11. A. Details from quartz-arenite stelae and their replications A: Left, Capilla I (Es 23). Right, replication stela (Es 14), with sidelight. B: Left, Capilla VIII (Es 27). Right: replication stela (Fotos: R. Araque). C. Line cuts and selected line profiles on Capilla I after 3D-modelling (digital model and drawings: María Eugenia Polo).

tinolite skarn, delivered reasonable results. The problem remains that all lithic tools, as observed on the experimental granite aplite, soon require time-intensive sharpening. On the other hand, the same lithic tools worked perfectly to carve the meta-sub arkoses. This rock also inspired the combined use of diverse techniques, including pecking and incision, due to its heterogeneous composition.

Lithic tools could not carve the characteristic precise edged lines that are observable on those stelae that were made from the hardest rocks, namely the silicate quartz-arenites. The different types of mono-mineral quartz or quartzite tools, whether used as chisels, tapping stone, or shafted as adze-hammers, were incapable of carving accurate lines with u- or v-shaped profiles that are characteristic for the original monuments. Both bronze and lithic tools can thus be discarded for the creation of stelae similar to the studied examples from the Zújar valley. Only a hardened C60 steel chisel, with similar technical properties as the analysed chisel from the FBA settlement Rocha do Vigio, could create the corresponding tool marks. Most importantly, the unhardened chisel from the same C60 steel was not useful and could not carve a proper line (Araque Gonzalez *et al.* 2023).

6. Discussion and conclusions

In the Chukotka valley (Russia), archaeological experimentation combined with traceological analyses have shown that rock art carved into the local compact sandstone was predominantly made with iron tools (Devlet 2012). The conducted analyses could discard both quartz, which was too brittle and created clearly different dentations, and tin bronze, which was too soft to engrave this lithotype. The results required a reassessment of the Neolithic chronology that had formerly been attributed to the

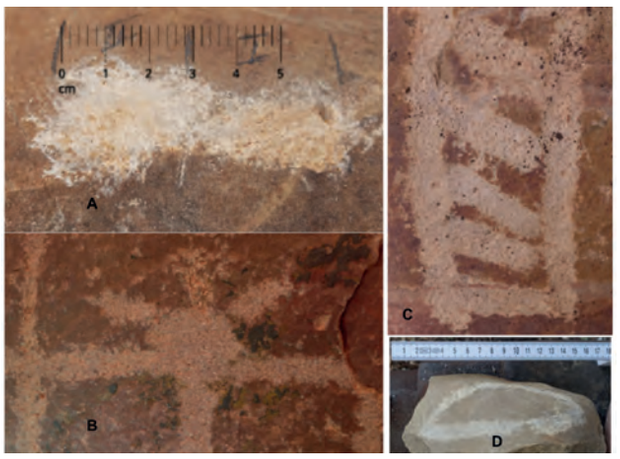

Figure 12. Frayed lines: A. Line on experimental stela, pecked with diablastic quartzite tool B. Detail from the Zarza Capilla II stela, C. Detail from the Belalcázar, El Mato stela (Es 24). D. Line on silicate quartz sandstone, pecked with chert tool (Fotos: R. Araque).

Chukotka engravings, based on their iconography alone. This shows the importance of a combined experimental, material science, and traceological approach. Similarly, in the absence of excavated archaeological contexts, up until now the Iberian stelae could only be dated on the base of the depicted artefacts, some of which were in use over several centuries (Brandherm 2013; see Paniego, this volume).

Based on this research, the availability of hardenable steel and knowledge of the hardening process to maintain these tools were preconditions for making the silicate quartz-arenite stelae. Consequently, the introduction of iron metallurgy could establish a *terminus post quem* for at least the corresponding group of stelae in the Zújar and Guadiana valleys. The results from the presented experiments and analyses suggest that the required iron working technologies were possibly known to Iberian craftspeople as early as the 9th century BC. Concerning early Iberian iron metallurgy, technological transfer might be indicated by the square tuyères that have been found in Rocha do Vigio, which were scorched and used. This type of tuyère is explicitly associated with iron metallurgy in the Levant (Veldhuijzen and Rehren 2007; Yahalom-Mack and Eliyahu-Behar 2015). Communities in southwestern Iberia had firmly established direct or indirect contacts to eastern Mediterranean regions at the beginning of the first millennium BC, presumably via the island of Sardinia (see Araque Gonzalez 2023, with further bibliography).

During the first phase of experimentation, the chisel from Rocha do Vigio had not yet been analysed and replicated, hence no comparable steel tool has been tried on granite aplite and meta-arkoses. However, Iberia's oldest known iron artefacts have been discovered in the Portuguese Beira (Jambon *et al.* 2023; Vilaça 2013), where also a number of stelae have been found. Therefore, an extension of the experiments and a traceological evaluation comparing the lines carved with steel and lithic tools into granitoid rocks could provide important insights into the technology used for these monuments, and might challenge the chronology of the stelae and the earliest iron technology in Iberia alike.

After the impressive walled settlements and megaliths dating from the Neolithic to the Early Bronze Age, there was no monumental stone architecture in Iberia during the FBA-EIA transition until the full Iron Age. Hence, it is striking that the knowledge of the properties of rocks and the skills of working them appear to have been used exclusively for the production of stelae and rock idols during this period (cf. Diaz-Guardamino 2010; see Rammelkammer, this volume). Finally, the western Iberian stelae provide essential insights into the reciprocal relationships of stone working and metallurgy. It appears to be no coincidence that some artisans preferably chose the hardest rocks, which constituted a true challenge and required specialist skills on the side of the sculptors as well as the toolmakers.

Acknowledgments

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CHAPTER 13

A blacksmith's perspective on experimental bloomery smelting and early steel

Thomas Mink

Abstract

The discovery of a refined steel chisel from Rocha do Vigio (Portugal), dating to the 9th century BC, together with slags and rests from metallurgical hearths or furnaces led to the hypothesis that iron was locally smelted at a previously unexpected early stage in Iberia. Subsequently, experimental archeological work has been carried out based on the construction, drying, and operation of a direct reduction furnace, with a truncated conical shape, similar to those found in pre-industrial contexts throughout Europe and the Iberian Peninsula. This method consists of the extraction of iron from the minerals that contain it, by applying heat in the absence of oxygen, which allows obtaining metallic iron directly, without going through a liquefaction or melting stage. This contribution includes an analysis of the chemical reactions involved in the entire process, an approach to the properties of iron / steel and the refining of the bloom.

Keywords: iron technology, direct reduction, bloom, metallurgical furnace, tuyère, iron

Resumen

El hallazgo de un cincel de acero refinado procedente de Rocha do Vigio (Portugal), datado en el siglo IX a.C., junto con escorias y restos de hornos metalúrgicos, condujo a la hipótesis de que el hierro se fundía localmente en una fase temprana hasta entonces inesperada en Iberia. Posteriormente, se han llevado a cabo trabajos arqueológicos experimentales basados en la construcción, secado y funcionamiento de un horno de reducción directa, de forma troncocónica, similar a los encontrados en contextos preindustriales de toda Europa y la Península Ibérica. Este método consiste en la extracción del hierro de los minerales que lo contienen, mediante la aplicación de calor en ausencia de oxígeno, lo que permite obtener hierro metálico directamente, sin pasar por una etapa de licuefacción o fusión. Esta contribución incluye un análisis de las reacciones químicas que intervienen en todo el proceso, una aproximación a las propiedades del hierro/acero y el refinado de la lupia.

Palabras clave: tecnología del hierro, reducción directa, lupia, horno metalúrgico, tuyère, hierro

1. Introduction and a brief history of iron

This research is based on eight years of experimentation conducted by myself, encompassing approximately 50 iron reduction tests with diverse furnace designs that cover a chronological span between the 4th century BC to the 17th century AD. The iron minerals used for smelting were hematite from different locations, limonite, goethite, siderite and magnetite, and from my experience, the easiest to reduce minerals were limonite and hematite. The obtained iron and steel blooms were consolidated and forged by my-

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self, being the only person in Spain who still carries out these tests continuously and successfully[9].

I will present the construction process of the furnace in greater detail, including its measurements, the tuyères, the roasting and crushing of the minerals, as well as the crushing of the charcoal, although I will not delve into charcoal making. I will explain the operation of the furnace, the extraction and consolidation of the bloom, as well as the workshop methods to measure the carbon contents of the obtained material. Obviously, as I work alone, we should not see this experimental archaeology project as an exact reproduction of the work of the smelters from 2000 or 3000 years ago, but rather as a learning process for future research encompassing the collaboration of blacksmiths, archaeologists, historians, and weapons experts, amongst others.

Iron is the fourth most abundant element in the Earth's crust, after oxygen, silicon and aluminum, with its atomic number being 26 and its symbol "Fe". In nature, it mainly appears in the form of minerals such as hematite (Fe2O3) and magnetite (Fe3O4), which are oxides, but also, however to a lesser extent, as carbonates (FeCO3) and sulfides (FeS2). Additionally, meteoritic iron was worked and used for tools and weapons in times before the discovery of direct reduction, and still thereafter. Splendid examples for the use of this material are the set of chisels, a decorated dagger, and other objects that were discovered in Tutankhamun's tomb in Egypt (Broschat *et al.* 2022), dating to the 14th century BC. In Iberia, two meteoric iron ornaments have been found in the Final Bronze Age (FBA) Treasure of Villena (Rovira-Llorens, Renzi, and Montero-Ruiz 2023). However, this material does not have to be smelted and hence has no relevance for the process described in this chapter.

The process that we are going to analyze in this paper was the common method of iron extracting from the minerals for more than three thousand years in the Mediterranean region, and for almost four thousand years in western and central Africa (Holl 2020; Zangato 2007). There certainly was technological evolution of the bloomery process (for example the so-called Catalan process, an improvement of infrastructures and processes developed mainly around the Pyrenees, from where it expanded), continuing until the end of the Middle Ages, in which the so-called «Stückofen» (with automatized, water-driven ventilation) appeared in central Europe, however without replacing the traditional, smaller bloomery furnaces, with which they coexisted until the invention of the blast furnace in parts of Europe during the 13th century (Pleiner 2000, 82–86). Notably, the blast furnace was already invented in China in the 5th century BC, after the bloomery process had been introduced in the 8th century BC, probably inspired by its western neighbors (Wagner 1999). The fundamental difference between a direct reduction furnace and a blast furnace is that in the latter, the metal takes a liquid form due to the much higher carbon contents as well the higher temperatures; contrariwise, in the bloomery furnace, the iron remains in a solid state.

2. The furnace and its construction

The furnace that I reconstructed was of the Gallo-Roman type (cf. Gener 2010), which consists of a chimney-shaped structure, approximately 80-90 cm high, slightly conical, and built in adobe. The interior had dimensions in the combustion chamber of about 25 cm, while the mouth of the chimney measured about 20 cm, with the thickness of the adobe at the base being 15 cm and at the top 6-7 cm. This was done by mixing clay with straw or dry grass to a plasticized consistency, in order to shape the adobe correctly (Fig. 1). I started by preparing the base of the oven, about 10 cm thick, made with the same clay, however without straw. I left it slightly inclined, so when the slag formed during the process, it was easier to be tapped from the furnace. On the furnace base, I placed a sheet metal tube, around which I applied the adobe.

This mould makes the construction of the furnace easier and faster. To make sure that the adobe could support its own weight, a small fire was lit outside and around the furnace, to accelerate the drying process. However, this is a trick we use nowadays, because of our haste, but in the past the drying process probably took much longer and was left to natural sun, air and winds, for the structural benefit and functionality of the furnace.

[9] *Intsead of a preface (by Ralph Araque Gonzalez)*. After it had been discovered that some southwestern Iberian stelae, especially those from extremely hard rocks such as the silicate quartz arenite monuments from the Zújar and Gaudiana valleys in Spain (see Ferreiro Mählmann *et al.* this volume) were apparently made with hardened steel tools (Araque et al. 2023), the ancient blacksmith's techniques were recognized to be of high relevance for this research. The discovery of an iron chisel dating to the 9th century BC in the Rocha do Vigio in Portugal, some 150 km down the Guadiana river from where the silicate quartz sandstone stelae have been found (see Mataloto, this volume and Araque *et al.* this volume). Together with this chisel, slags and tuyères to be used with a metallurgical furnace or hearth have been found (Calado *et al.* 2007). Analyses of the chisel showed that it had a partly very high carbon content (up to 0.77 wt%), and was thus hardenable (see Asmus, this volume).This led to the question when the first iron smelting began in Iberia and which quality material could be obtained from bloomery smelting of the local iron ores. Moreover, it became important to understand the technological knowledge and possibilities of the earliest Iberian smelters. Therefore, we contacted blacksmith and smelter Thomas Mink to join this research with his ample experience and knowledge of iron smelting with ancient methods. Within the framework of an archaeological experiment, he produced an iron chisel from hematite minerals with the bloomery smelting process and refined the resulting bloom, a crude iron sponge or lump, in his workshop. It is essential for our understanding of ancient technologies to reconstruct the process and assess scientifically which were the possibilities and limitations of ancient craftspeople. In this chapter, Thomas Mink presents for the first time the process that he uses in his numerous experiments and shares invaluable, experience-based knowledge of almost forgotten smelting and forging techniques.

Figure 1. Construction of a furnace at the experimental archaeology laboratory of the Universidad Autónoma de Madrid (UAM) (Foto: T. Mink).

Figure 2. Tuyères of different sizes, drying in the forge (Foto: T. Mink).

Once the furnace was finished, I made an opening at its base, taking care not to damage the interior, and checking that the small slope is still intact. Through this opening, a fire in the interior was lit, and kept burning for at least six hours, until the furnace was completely dry. It has to be taken into account that the cracks that appeared in the wall of the furnace had to be constantly covered with clay in order to prevent the gases from escaping during the later smelting operation. Once the furnace was dry and cooled down, I moistened the internal part with water to apply a finely sieved clay paste to reduce any irregularities on the wall to a minimum. This shall enable a better downward movement of the charcoal that will be filled inside the furnace, where it is consumed by fire in its lower part, as well as to achieve a better gas movement of carbon monoxide. It had formerly been described that in the past, special preparations of refractory mortars, composed of clay, manure, and ash, were used and applied whenever the oven was reused (Gallego Cañamero 2013). However, this was not necessary or essential, since according to my personal experience it hardly improves the performance.

Next, I had to install the tuyère, which is a very sensitive task, since the proper functioning of the furnace largely depends on it. First, a properly fired clay tuyère that resists the high temperatures in the combustion chamber had to be manufactured (Fig. 2), however almost always, most of it has been consumed inside the furnace. The interior of the tuyère was conical, with a diameter at the entrance of 3 to 3.5 cm and 2 cm at the exit to the combustion chamber.

Currently, I prefer to use copper tuyères, which have the same operation and performance, but this saves me the effort of making new clay tuyères for each use. The placing of the tuyère has to be calculated, based on the size of the furnace and the iron bloom that is aimed to be obtained. For the size of this furnace, which was ca. 80-90 cm high, the tuyère should be located ca. 15 cm above the interior base of the furnace, with an angle of between 17°-25°. The greater the inclination, the higher the heat that can be reached in the combustion chamber, and therefore, the greater the carbon consumption. Depending on the mineral used, the angle could be adapted, for example it should be increased for magnetite; however, for the hematite used, an angle around 20° or even less was sufficient. I had formerly also obtained satisfactory results by installing the tuyère horizontally. This was done by drilling a hole in the furnace wall at the desired height, inserting the tuyère and fixing it with stones and clay in the desired position, while inserting it into the combustion chamber about 5 cm (Fig. 3). However, this resulted in a somewhat lower weight performance of the bloom, due to lower heat, lower carbon consumption and therefore lower carbon monoxide production, which in turn lowers the reduction performance.

It is not known from archaeological finds what type of bellows were used in prehistory, however it will here be assumed that they were similar to drum-type bellows (Fig. 4). However, different types of bellows, as well as natural wind ventilation and blowing tubes, are known from African ethnographic records of bloomery smelting (Celis 1991; Zangato 2007; Holl 2020). For our purpose and according to traditional blacksmith experience, the size of the drum bellows should be approximately half the volume of the oven (Thijs van de Manakker, Facebook message to author, 2017). Since I often do not have help, I used an industrial blower in this experiment, which pro-

Figure 4. Two self-made drum bellows (Fotos: R. Araque Gonzalez).

Figure 3. Interior of a furnace that was built at the blacksmiths' meeting in Estada (Huesca, Spain). The tuyère is visible at the top of the image. This furnace did not have an interior coating, due to the lack of time for its construction (only two days). Although this greatly reduced the smelting performance, the result was still satisfactory (Foto: T. Mink).

Figure 5. Typical setup for my experiments (Foto: T. Mink).

vides a sufficient amount of air together with the appropriate pressure (Fig. 5).

3. Preparation of the ore and charcoal for the operation of the furnace

The Iberian Peninsula is very rich in iron ore deposits, and for this experiment, I used hematite with ca. 55 wt%- iron from the Esperanza mine[10] in Olmos de Atapuerca (Burgos). Hematite is an ore of ferric oxide with the chemical formula Fe2O3, which is arguably the most important iron ore in the world[11]. Apart from the production of iron, the red variety of hematite is used as a pigment and as a polishing agent; its currently largest exporter in the world is located in Tierga (Zaragoza, Spain).

Initially, a selection of the best pieces for smelting (assessed by colour, weight, purity, few inclusions of other minerals) had to be made from the collected mineral at its ore source. Once this assessment had been made, a campfire was prepared and the pieces of ore were placed within it. This process is called roasting and is essential to guarantee a proper furnace operation. The purpose of roasting is to clean the mineral to be used in the furnace; its benefits are the following:

- Complete drying of any contained moisture, removal of the chemically bound water.
- Burning of undesirable elements for the reduction process, such as sulfur, phosphorus, etc.
- The conversion of compact into porous material, as the different elements burn and evaporate.

[10] www.minaesperanza.com
[11] https://geology.com/minerals/hematite.shtml

- Greater surface area for a chemical attack of carbon monoxide in the reduction process.
- Facilitate the crushing of the pieces to small bits to feed the furnace.

Additionally, the roasting offers the possibility for a final selection of the ore, since the temperatures of a bonfire, without additional air supply, usually reach 850° C (measured with a pyrometer), which causes the beginning reduction of hematite (Fe2O3) to magnetite (Fe3O4) within the mineral, which then becomes magnetic and this property can be used to check the iron content of pieces prior to crushing. The appropriate granulometry for the mineral for use in a bloomer furnace of this type is a particle size of 0.2 to 0.7 cm, with a maximum of 1 cm, otherwise it is not capable of reducing it completely. It must be noted that a too small granulometry hampers the necessary circulation of gases.

I used holm oak (*quercus ilex*) charcoal, since it provides enough calorific power to avoid problems of lowering temperature and produces enough carbon monoxide for reduction; however, any other type of good quality charcoal could be used. The pieces of charcoal, especially greater chunks, had to be crushed to a suitable size for the type of furnace. This must be done because if the pieces are too small, they are consumed very quickly, which raises the temperature too high and potentially liquefying the ore by turning it into slag without reducing it. When the pieces are too large, the appropriate temperature might not be reached and the monoxide from the combustion could escape too quickly from the furnace, without having time to reduce all the ore.

Once the components were prepared, the furnace had to be put into operation. After the blower was already connected to the tuyère but not in operation, I prepared a small fire inside the furnace through the opening at its base. Slowly, the fire gained strength due to the natural draft of the furnace acting as a chimney. Soon after, I began to add pieces of uncrushed charcoal in order to make them burn. Once they had caught fire, I covered the bottom opening of the furnace, switched on the blower and adjusted the power to the appropriate level. This process has been developed completely empirically and was first based on the observation of the color of the burning charcoal, which should be yellow-white from my perspective. However, it is most important to assess whether it is a hot or a cold day, if the air is humid, windy, etc. As soon as the conditions can be considered appropriate, the furnace can be filled up to the top with charcoal and mineral layers. This process can take up to half an hour, following the one to two hours of preheating to reach the operating temperature of around 1300° C.

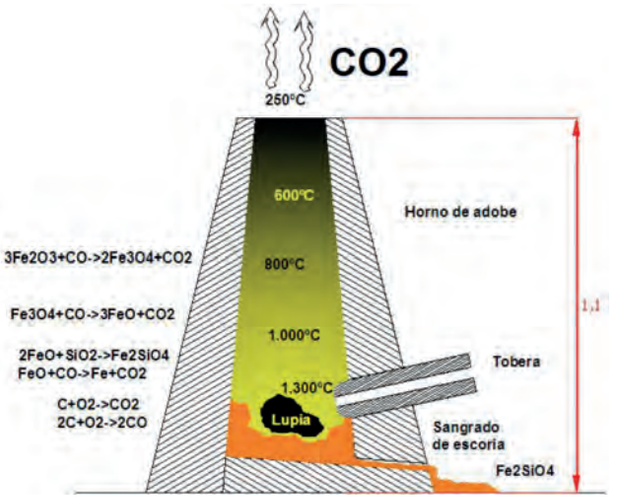

Figure 6. Schematic furnace and most common chemicals reactions (Drawing: T. Mink).

During the preheating, the quantities of each load of ore and charcoal that will be poured into the furnace have to be calculated. The ratio of ore to charcoal varies between 1:1 and 1:1.5, depending on the mineral that is used. For the hematite ore from Burgos that was used, I decided on a weight ratio of 1: 1.15 of charcoal, hence in this case for every 400 grams of mineral, 460 grams of charcoal were added. To organize the entire process, I prepared plastic cups of different sizes, in which I weighed the necessary amount.

4. Direct reduction and chemical processes

Now it is time to take a look at the reduction process inside the furnace. Reduction is a chemical reaction, which can be explained, in our case, in a very simple way: it involves removing oxygen from the iron oxide, so that the final result is purified iron that can be extracted from the furnace. In the following image we can see the processes that occur in the furnace described in a schematic way (Fig. 6).

In order to make the reduction process work, a reducing atmosphere, rich in carbon monoxide, is required. The forced combustion of the charcoal and an almost closed structure create conditions inside the furnace which should be are appropriate for a proper reduction. As the roasted and crushed ore descends and is distributed through the furnace, it begins to reduce; the higher the concentration of CO and the higher the heat, the more efficient becomes this process. The reduction begins at 800°C, which is reached when it goes approximately halfway through the furnace from the top. The abundant amount of monoxide reacts with the oxygen of the oxides in the mineral, converting it into carbon dioxide. Before tearing it off, it binds to the hematite (Fe2O3), converting it into magnetite (Fe3O4). As the ore continues to descend and the tempera-

Figure 7. Tapping with a good slag output from the furnace (Foto: Jose Salgado).

Figure 8. Example of a bloom that has grown below the tuyère. The deformation that the air flow has created on it is clearly visible. The direction of the air stream is visible as it hit from the left side and pushed the iron particles to the right (Foto: T. Mink).

ture continues to increase, the CO binds to the oxygen of the magnetite, removing it and converting it into wüstite, which is a simple iron oxide. In this moment, the mineral reaching a temperature of 1100ºC, another vital important process occurs: the gangue (the rest of the minerals that contain the hematite) begins to liquify. This is called the slag, which accumulates at the bottom of the furnace. Finally, down in the combustion chamber, the wüstite will lose its oxygen atom and the metallic iron particles will remain, which will them consolidate below the tuyère. It must be taken into account that the melting point of iron is 1538º C, so its aggregate state inside the furnace remains solid. Moreover, the iron absorbs carbon by diffusion due to the temperatures inside the furnace, which lowers its melting point, in a way that it reaches welding heat that is ideal for joining the pieces and form the bloom. This refers to the iron sponge that grows throughout the process, until it reaches the nozzle of the tuyère and plugs it; it must be noted that this might also occur with a drop of slag at any time during the process.

Based on the smelter's experience, approximately four or five hours of operation are enough to obtain a bloom from a furnace of this size. For a good and solid formation of the iron bloom, with few inclusions, the furnace has to be tapped, that is, punctured or pierced its wall in the lowest part and drained of the liquid slag (Fig. 7). This was done with a 20 mm solid round bar (although any other appropriate tool from other materials could be used), which was used to pierce through the furnace wall into the combustion chamber, while trying to adjust the strike to above its base. Depending on the ore used and on the possible use of flux, the slag might be more or less liquid, and it has sometimes happened that the slag was so dense that it could not flow out of the furnace and acted as a bed for a good bloom instead.

The slag binds most of unwanted, non-gaseous chemical elements. It consists of molten gangue, fuel, ash, clay, and iron silicate. This main component of the slag is called

Figure 9. Bloom extraction during a course I offered at the Blacksmithing school of Ramón Recuero (Toledo) (Foto: courtesy of T. Mink).

fayalite (Fe_2SiO_4), and this furnace residue contains a part of the iron that should be obtained. In furnaces of the size used in the experiment, three to five slag tappings during the process were usually sufficient. The first tapping should be done 1.5 hours after the first load, the second 50-60 Minutes later, and the last one just before opening the furnace to extract the bloom.

Figure 10. Once the bloom has been removed from the furnace, an initial refinement can be carried out by taking advantage that it is hot enough. This is here done on an anvil, although a wooden log would be ideal to keep the welding temperature (Foto: T. Mink).

When the reduction process is advanced, the decision to open the furnace has to be made in the right moment, which can be calculated from the ore and charcoal loading times. Mostly, as soon as they start to get longer, this tells us that the bloom has grown into the tuyère, resulting in either the air colliding with the bloom or the bloom directly blocking the tuyère.

Another indicator of a successful and finishing reduction is the color of the flame in the furnace. Throughout the process it remains slightly yellow/bluish, sometimes even transparent, and it turns yellow towards the end. Additionally, there is a perceivable change in the smell of the combustion. After all these conditions appeared favorable, I took the decision to open the furnace and extract the bloom (Fig. 8 & 9).

In order to extract the bloom, the wall of the furnace must be broken in an area of at least the approximate size of the opening that was made to light the fire and dry the oven, however in most cases a much wider hole must be opened. This can be complicated, because as soon as the furnace is opened, the remaining liquid slag immediately solidifies due to the temperature drop. The iron sponge, or bloom, can then get stuck to the wall or bottom of the combustion chamber. In some cases, the entire furnace must be demolished to access the bloom. However, when this is not the case, the furnace can be reused up to three or four times, according to my own experience.

When the extraction can be accomplished rapidly enough, the blacksmith can take advantage of the fact that the bloom still has welding temperature and give it an initial refining to extract much of the slag inclusions. For this purpose, a wooden log of suitable diameter is ideal to be used as an anvil, on which the bloom can be placed and worked with a large wooden mallet, since the time window for refining is larger this way: the hot iron does not cool as quickly with wood as if it would be in contact with a steel anvil and hammer.

Most blooms that I have obtained with this method were practically soft iron, although it has happened on certain occasions that the produced iron absorbs a sufficient amount of carbon by diffusion to become steel. Steel is defined as an alloy of iron and carbon, containing between 0.25 and 2.1 wt% carbon. The relationship of carbon to the hardenability of steel, for which it is the responsible element, had not been officially discovered until the end of the 18th century AD. Nevertheless, this does not mean that in ancient times, the blacksmiths did not have a good knowledge about the qualities of steel compared to iron. They knew how to recognize and differentiate it to be used in tools and weapons, where its hardness and other properties were required. For example, in the case of the Roman mines in Noricum (Austria), an iron ore that is rich in manganese was extracted, which helped the absorption of carbon. Therefore, the direct result of the reduction process was proper steel and this quality provided a strategic resource (Gener 2010).

To obtain steel in the direct reduction furnace, it must be understood under which conditions iron absorbs carbon and how to provide these conditions. This is called the carburization process, which begins at a temperature of ca. 900ºC, where carbon monoxide reacts with the iron, leaving carbon in the solution. This results in a diffusion (or flow) of atoms, during which they move from an area of high carbon concentration into an area with a lower one, until a rather uniform distribution is obtained in the metal, balancing the concentrations.

To get to this result, the furnace has to be operated at a slightly lower temperature, so that the iron, after being reduced, has sufficient time to absorb carbon before beginning to consolidate in the bloom. This way, we will convert our reduction furnace into a cementation furnace. The overall process remains the same, but instead of allowing the bloom its maximum growth, it is left slightly smaller, because we stop providing ore and only load charcoal into the furnace, whereby the entry of air and heat can be controlled. One problem that occurs when the air is blown directly upon the bloom is that the carbon contribution that was achieved previously is then lost and the airflow will decarburize the iron. This process works exactly the same way as carburization, however in reverse order and results in the carbon content being almost completely eliminated through the equilibrium of concentrations.

Once the growth of the bloom has been stopped, the air flow must be reduced in order to lower the temperature in the combustion chamber down to 1000-1100º C and

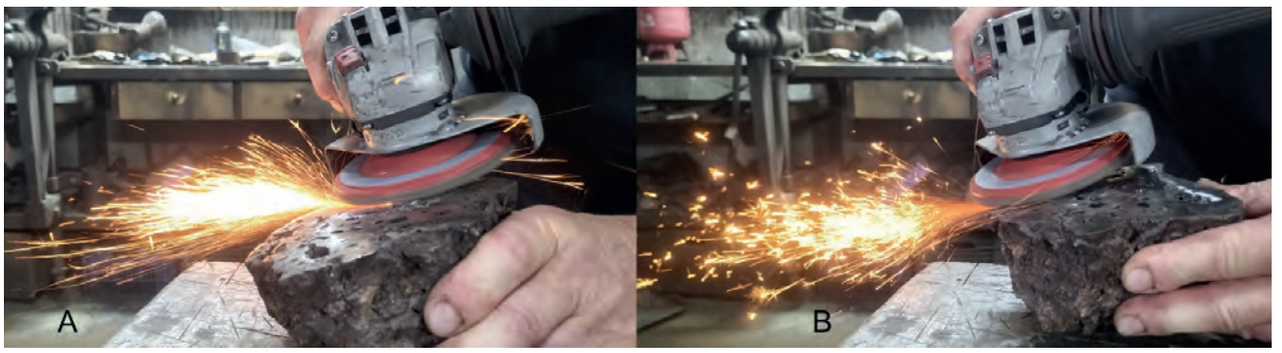

Figure 11. Spark test by cutting a bloom with a high carbon content, which renders it hardenable. There are plentiful starry sparks that open quickly (Foto: T. Mink).

this must be maintained for at least few hours (the longer the better), until the bloom is sufficiently carburized. In the next step, it can be extracted and used for a first refinement.

The reaction is as follows: Fe + 2CO C (in Fe) + CO2

Since I usually do not have scientific or industrial analytical methods to know how much carbon has been absorbed by the steel, spark testing is a method that allows us to recognize, from experience, the approximate carbon content. To perform the test, we cut the bloom with an angle grinder and observe the sparks: the greater the number of starburst sparks and the closer the opening is to the cut, the higher the amount of carbon (Fig. 11). This method is relatively reliable for unalloyed or very low alloy irons (apart from the carbon), however not for modern steel alloys, which often contain additional elements such as for example vanadium, silicon, tungsten, and molybdenum, which all falsify the spark test results.

However, there is another, more traditional method to assess whether a bloom contains sufficient carbon by splitting it in the hot state, for example using a chopping block, down to manageable sized smaller pieces in the forge. Subsequently, the fragments are heated to welding temperature (1100-1200° C) and then refined by hitting the pieces on the anvil. Before or during the heating, some type of flux, for example river sand, is poured onto the pieces of bloom, in order to lower the melting point of the slag and the iron oxide scales induced by contact of the hot metal with the air, so that the welding associated to the compacting would be completely clean. It is forged to a thickness of approximately 1 cm and, by taking advantage of the residual heat of the piece, at about 750° C (which can be recognized by the incandescent colour), it is quenched in water. After this, the piece breaks when hit sharply on a concave tool if has more than 0.25 wt% carbon, which is steel. This is due to the brittleness of quenched but not annealed steel, which is comparable to that of glass. On the contrary, those pieces with a lower carbon content bend without breaking under this test.

5. Bloom refining

Once the raw iron sponge material is obtained from the furnace, this bloom must be prepared for forging. First, it must be broken or cut into smaller, manageable pieces for the forge. Since my forge blows vertically and the air (the tuyère) enters the hearth from below, I have to modify it by replacing it with another horizontal tuyère. This must be changed because when the bloom fragments are heated to the point of welding temperature, the slag begins to liquefy and would hence seal the vertical tuyère.

Some type of flux must be added while the piece is hot, which will liquefy upon contact with the material and helps in the welding and to achieve the cleanest possible refining. Nowadays we use borax (sodium tetraborate, Na2B4O7·10H2O), which has a relatively low melting point and it is not necessary to add to the pieces to be soldered in the forge. However, this was done in the past with other types of fluxes, for example fine river sand or the sand of grinding wheels for polishing and sharpening swords were used as a flux, as it has been described by Palomares 1772 (Pelaéz Valle, 1986). Together with the iron scale, this produces fayalite, effectively doing the same as borax, just at higher temperatures.

While the material is still at welding temperature, it is taken out of the forge and tapped lightly, so that the slag, scale, and charcoal are separated and a clean weld without inclusions is obtained. In summary, the hot welding or heating process is taking advantage of the heat in the forge to join two pieces of iron or steel. The combination of heat and pressure by hammering produces a diffusion phenomenon between the iron atoms of both pieces' surfaces, resulting in their unification by welding them together (Fig. 12).

This bloom refining process is time-intensive, since the pieces must be subjected to successive heating, in which the material must be stretched, then folded in half, and welded again. All this has to be repeated as many times as necessary until most of the inclusions are eliminated. This transformation of the raw bloom material into forgeable

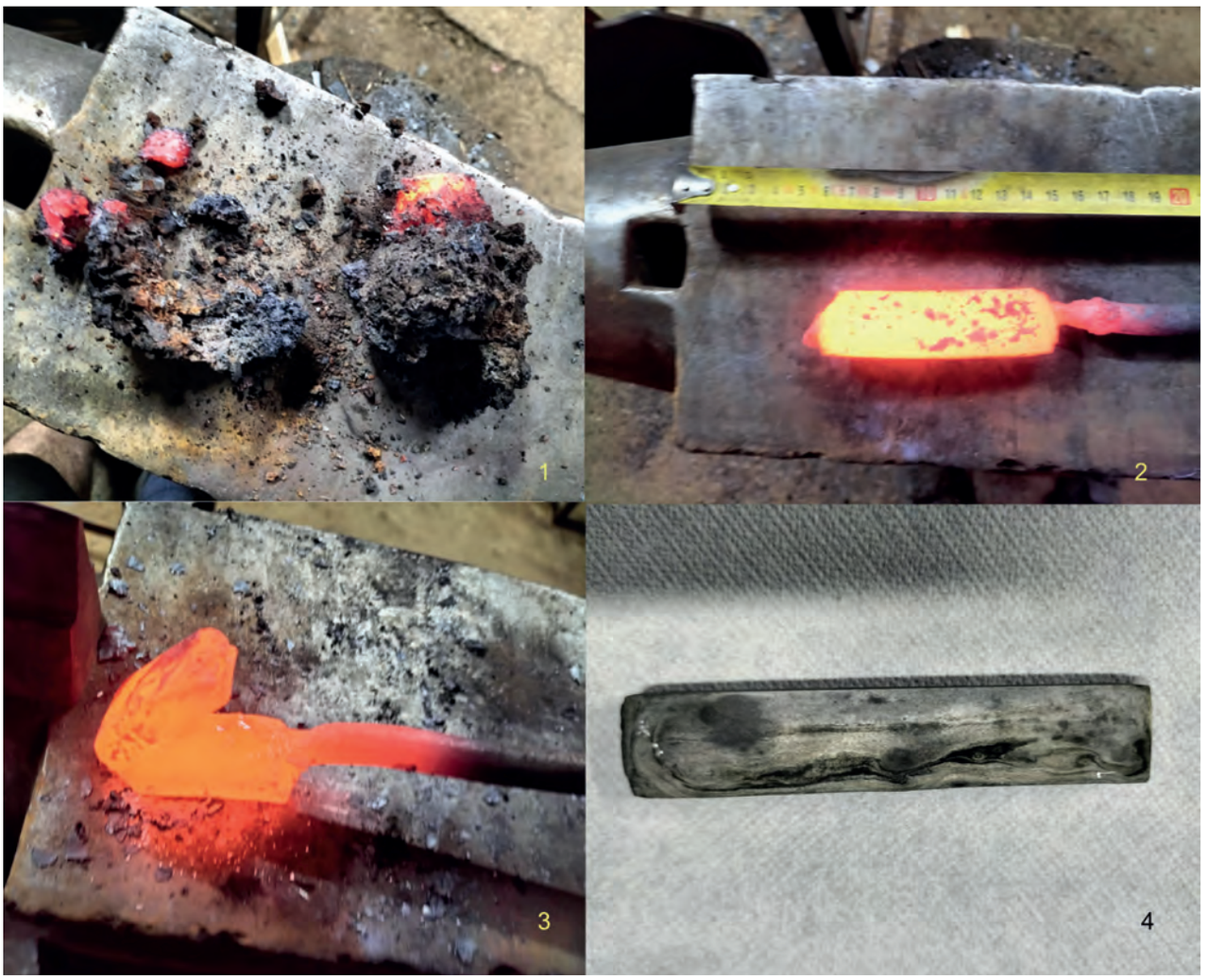

Figure 12. (1) Transformation from pieces of the bloom through (2) refining and (3) welding to (4) a piece of refined steel, etched to reveal the different carbon (the darker, the higher) contents in the welded layers, with some slag inclusions (Fotos: T. Mink).

pieces of refined iron considerably reduces its initial quantity, by up to 30-35% of its weight and even more by volume. This is due to the mass of the slag and the other material inclusions that are being lost with each heating.

6. Result: Iron, refining and forging

The most important difference between modern iron and steel if compared to reduction (or wrought) iron is that wrought iron has fiber, or as we blacksmiths call it, grain. It is important to note that today we must differentiate between fiber and grain, the grains being the microscopic crystals within the iron and the fibers being the iron silicate threads or strands (slag) in the iron. This could be compared to wood: if we try to drive a nail near the edge of the wood, it will splinter. The same will happen to reduction iron if you punch a hole too near the edge.

The finished piece of iron contains small traces of carbon, which are irregularly distributed within the refined piece. Although the refining process, with its many stretching, bending and removal of bloom pieces, relatively homogenizes the carbon distribution. Therefore, certain parts may be harder steel and others soft iron in the same solidified piece. This difference is common and can be felt while working with the material, as I encountered it in several occasions during restorations of 18th century AD ironwork. Additionally, it is noteworthy that this material originates from an iron sponge and contains many impurities (slag and unburned charcoal, Fig. 12.4), making it a much more ductile material at forging temperatures than modern iron. Moreover, due to its properties, it is an extremely easy iron to weld in the forge. One of the reasons for the good welding properties is that due to the high content of slag inclusions, this reduction iron is a self-fluxing material. This property was formerly used to such an extent that in many antique iron pieces, countless welds can be found, for example sometimes 8 to 10 small pieces of iron were welded to obtain a simple plate with a length of 13-15 cm. This can be explained by the fact that iron was never an abundant material until the arrival of industrialization and that the recycling and reuse of any disused object was common.

I refined the bloom from this smelting experiment and forged a chisel similar to the archaeological find from Rocha do Vigio. As commonly, soft iron was obtained from the smelting, which is difficult to harden through quenching. Moreover, the forging of this type of iron is very different from the iron obtained from blast furnaces. It is softer and much easier and better to forge, however this particular bloomery iron was not hardenable due to the low carbon content. In future experiments, the process will be adapted and we can force the furnace to create steel, in order to forge a hardenable chisel with a similar carbon content to the Final Bronze Age find that will be suitable to carve silicate quartz arenites.

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CHAPTER 14

An archaeometallurgist's perspective on slag, bloom, iron, steel and some thoughts on the inception of hardening

Bastian Asmus

Abstract

This paper presents the analyses of the smelted iron and slag from an experiment carried out by Thomas Mink at UAM Campus in Madrid in 2023 (Mink, this volume). The smelting experiment was carried out as a preliminary step into the research of early iron production in the Iberian Peninsula. The results are compared to the steel chisel found in Rocha do Vigio (Araque Gonzalez *et al.* 2023). Finally, a few thoughts are presented on the likelihood of the inception of hardening.

Keywords: experimental iron smelting, metallographic analysis, slag analysis, steel, hardening

Resumen

Este trabajo presenta los análisis del hierro fundido y las escorias de un experimento realizado por Thomas Mink en el Campus de la UAM en Madrid en 2023 (Mink, este volumen). El experimento de fundición se llevó a cabo como paso previo a la investigación de la primera producción de hierro en la Península Ibérica. Los resultados se comparan con el cincel de acero hallado en Rocha do Vigio (Araque Gonzalez *et al.* 2023). Finalmente, se presentan algunas reflexiones sobre la probabilidad del inicio del endurecimiento.

Palabras clave: fundición experimental de hierro, análisis metalográfico, análisis de escorias, acero, endurecimiento

Introduction

Many skills need to come together to widen our horizon on our view on the past. First historians began to record events of the past, later archaeologists dug up material imprints of the past, and in the last five decades, new scientific approaches deepened our understanding of the past. Finally, in recent years, experimental archaeology and craft oriented science improved our understanding of all the craft processes our ancestors were involved in. This paper is the result of a collaboration of many people dealing with all these aspects, unified in the aim to have a closer look at the so far rather little scrutinized emergence of iron technology. This paper would like to add some small contribution towards a better understanding of early iron technology by analysing a recent archaeological smelting experiment undertaken at the Universidad Autonoma de Madrid.

Observations

The smelting operation was carried out in a shaft furnace operated by forced air of a mechanical blower. The air rate was gauged by the smelter /blacksmith Thomas Mink empirically. Prior to smelting the furnace was dried and preheated with charcoal. The charcoal and ore, predominantly of haematite from Burgos were charged in a ratio of 1: 1.15. A total of 13.2 kg of charcoal and 11.55 kg of ore was used in the charges. The amount of charcoal to preheat the furnace was not recorded. For the minute details of the

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operation, as well as the emic view of the smelter/blacksmith please refer to Minks paper in this volume.

The smelting furnace was started at 9.40. fully charged with charcoal at 10.05 and preheated until 10.57, when the first charge of charcoal and ore were added. By 13.34 the 33. charge of charcoal and ore was added. The furnace was run further until at 15.11 the charcoal was burnt down so far that the furnace could be dismantled and the bloom could be retrieved. At 15.16 the bloom was cooled down in water.

A total of 33 x 400 gr = 13.2 kg of charcoal and 33 x 350g = 11,55 kg haematite ore were used.

All archaeometallurgical debris was collected directly by the author during the experiment in 2023. Slag was tapped intermittently during the smelting operation, when it started impeding the air flow into the furnace. There were five tapping events, with the last one moments before the furnace was broken up to retrieve the bloom. The slag displayed very low viscosity during tapping, and cooled very quickly. This resulted in black, glassy, rather brittle tap slag. The five tapping events were sampled individually, so as to monitor possible changes in their chemistry, texture or phase composition. The bloom was left to cool for a few minutes after opening the furnace and cooled down with water.

Methods

The slag, bloom and refined metal were sampled and prepared for incident light polarising microscopy. They were cut with a water cooled diamond saw, ground with SiC paper, and polished diamonds suspension of 3 µm and 1µm grain size. The metal samples were also prepared for metallographic examination. They were etched with 2% Nital for 30 s.

Results and Discussion

In the following sections the products and by-products will be characterised. The resulting slag, bloom and refined steel are characterised and compared with the the find from Rocha do Vigio. Finally, some mass balancing is undertaken to quantify the material flow and contribute towards a better understanding of the remainders of waste-, by- and end products.

Slag

During pyro-metallurgical production, several raw materials react to waste and desired end products. Next to the desired metal, waste- and by-products form, some of which escape in gaseous form and others remain as debris such as slag and vitrified furnace materials. Slag is made up from a slag forming component, usually an iron oxide, gangue material, melted furnace material and fuel ash and more or less completely reacted ore (Figure 1). In many cases the slag formation process can be regarded as auto-flowing when run within certain parameters (Kronz 2000). For the purposes of this paper, it is sufficient to acknowledge that the smelter, Thomas Mink, managed to control the parameters well within these constraints.

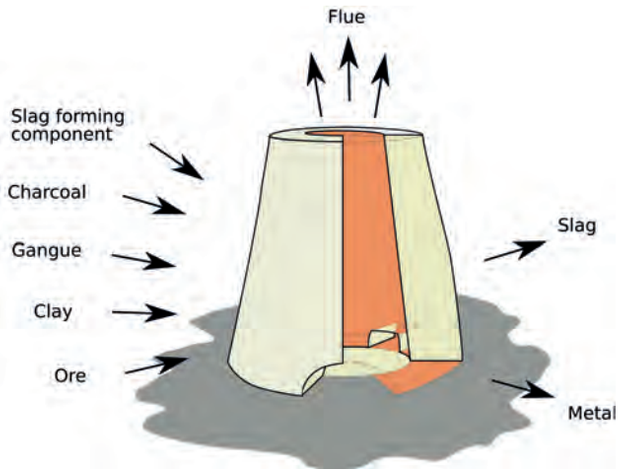


Figure 1: A schema of a smelting furnace, its educts, by-, waste and end products. Image: ©B. Asmus.

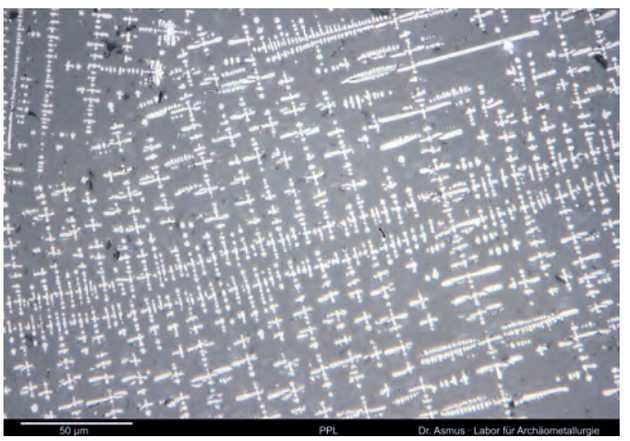


Figure 2: The image width is 275 μm, PPL. Third tapping event. It shows a typical section of the slag at high magnification. The only discernable phase is wüstite (white), the grey matrix is either a glass of fayalitic composition or submicroscopic fayalite. Image: © B. Asmus.

Slags were tapped in regular intervals and of each tapping episode a sample was prepared to test for temporal variability in the furnace conditions. The tap slags were of a jet black colour with very low viscosity, and drained very well from the furnace (Figure 2). The slag displays the typical ropey surface texture of many archaeologically retrieved tap slags. Due to their rapid cooling, they appear mostly glass, but frothy in the areas of fresh breakages, which happened easily with these brittle slags. These are by no means compact slags, but very porous ones. There were no inclusions visible macroscopically.

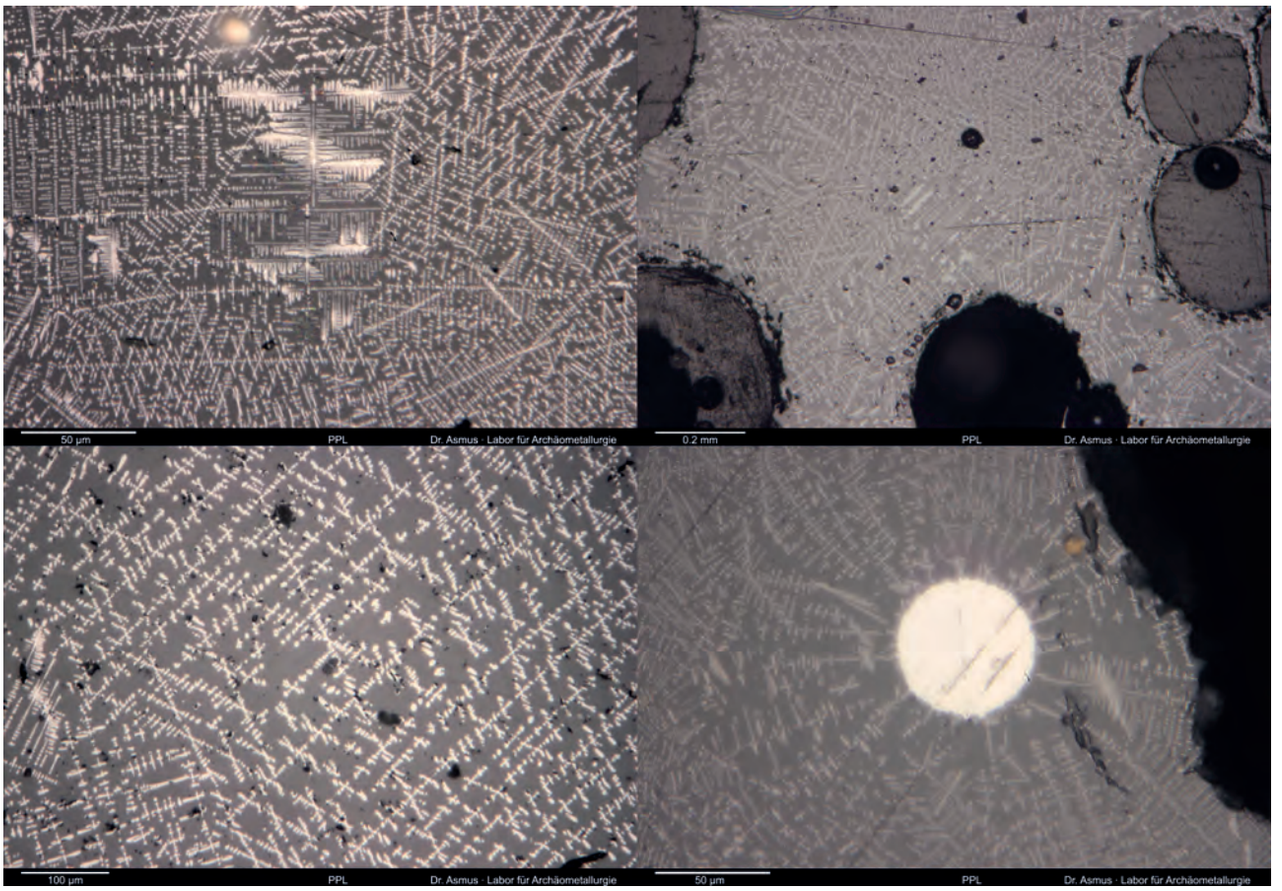


Figure 3: These are typical section for the five tapping events. Top left 1. tapping, there is only wüstite as discernable phase present, the matrix is either fine sub-microscopical fayalite, or a glass with near fayalitic composition. Top right: slag of the second tapping event. It is very similar in its composition. Bottom left is from the fourth tapping event and matches the slag from the third tapping event: This is wüstite in glass and/or sub-microscopical fayalite. Bottom left: The final tapping before retrieving the bloom. It is also very similar in it composition as well in its grain sizes. Image: © B. Asmus.

Microscopically, these are very homogeneous slags, with very little variation, neither in their phase composition, nor in their grain sizes. The main phases are wüstite, which appears in finely developed dendrites, the inter-arm spacing is between 2.5 and 5 µm. The individual thickness of the dendrites is in the order of 2-3 µm. (Figure 2). Table 1 presents the times at which the tapping events took place, as well as the approximate temperature of the slag, measured with an infrared pyrometer (emission grade =0,75), as well as the total masses of the collected samples. Figure 3 provides an overview of the sampled slags and their microstructures.

Table 1: The five slag tappings.

	Time	Temp in °C	Mass in g
Tapping event 1	12:11	1116	76
Tapping event 2	12:43	1115	112
Tapping event 3	13:05	1200	960
Tapping event 4	13:23	1158	1002
Tapping event 5	14:55	na	278
Sum			2428

Tap slag 1

This slag consists of wüstite in dendritic form, embedded in a grey matrix most probably of fayalitic composition, as well as the occasional iron prill. Due to the high cooling rate fayalite die not have time to form large enough to be discerned by optical microscopy (Figure 3, top left). There is some gas porosity, which rendered the slag rather frothy and brittle.

Tap slag 2

This slag possesses also dendritic wüstite, embedded in the same matrix as above (Figure 3, top right). There are also iron prills in this slag. It is however much more porous than the slag from tapping event 1. In a few regions of the samples, the fayalite phase could develop to recognisable dimensions.

Tap slag 3 and 4

These tap slags are identical. They are made up of dendritic wüstite embedded in a sub-microscopical matrix or glass of near fayalitic composition. There are no iron metal inclusions in these samples at all, which indicates a very good separation of metal and slag, which in turn shows that the slag possessed a perfect viscosity for the task at hand.

Tap slag 5

The fifth tapping event only tapped off the remaining slag its mass is rather small. The slag consists – again - of dendritic wüstite within a glassy matrix. There are some iron prills trapped within the slag.

Concluding, we may state that the slags from all the tapping events are remarkably similar, and there is no temporal variability of any significant scope. Their macroscopic appearance is mostly a function of the cooling rate, and where there is more slag to cool down it does so slower, in which case fayalite may form. The phase composition is very similar with small wüstite dendrites in either a glassy or sub-microscopic matrix. In a few occasions cooling rates were slower wüstite dendrites were embedded in fayalite crystals.

Figure 4: This image show a piece of furnace wall, that was vitrified during the smelting process in its inner regions. Note the thickness of the slag adhering to the walls, as well as the heat affected zone of the wall. Th grey clay indicates strongly reducing atmosphere, which reduced the iron oxides in the clay to FeO. Image: © B. Asmus.

Mass balancing

Of key interest to archaeology is, next to craft specific questions, the question regarding the estimation of the gross metal output in relation to the utilised ore quality. We would like to know how much iron can be expected to be produced in one furnace and smelting episode.

The carefully controlled experiment, along with all the measured educts and products enables us therefore to test the accuracy the mass balancing calculations based on the ore quality and slag masses.

We will therefore approach the mass balancing from two different directions.

1. based on the iron contents of slag and ore
2. based on the gangue contents of the ore

With an average iron contents of 55 mass% in the Burgos haematite, the 11.55 kg contain 0.55 * 11.55 kg = 6.35 kg of metallic iron. The nature of the bloomery process is such that much of the iron remains in the waste product: mostly fayalitic slag with a mean iron oxide (calculated as FeO) contents close to 60 mass%. This results in an iron concentration of some 47 mass% in the slag, which is irretrievable. Depending on the quantity of gangue and furnace material, the amount of slag can therefore be used to calculate the amount metal to be expected. Since all the masses are recorded in our case we can take the other direction and calculate an expected slag and iron output and compare this with the experimental result. The bloom that was retrieved had a mass of 2356 g; the ratio of ore to iron being roughly 5:1. The slag that was collected amounted to only 2428 g.

Of course the bloom does not consist entirely of iron, but also of charcoal and slag. Charcoal may be dismissed, due to its low density and general scarcity in blooms. The slag contents can only be guessed, and if we assume a tentative value of 250 g, this would leave 2.1 kg of metallic iron in the bloom. The remaining 4.25 kg of iron bound in the fayalitic slag. We would expect therefore altogether 4.25 kg/0.47 mass%/kg = 9.11 kg of slag. For the bloomery process this is a typical metal output. The smelting process was clearly well understood.

This discrepancy of calculated versus collected slag can be, at least partly, explained by the amount of slag that is fused to and reacting with the furnace wall. In Figure 4, you can see that the vitrified furnace wall has a lot of metallurgical slag adhering to its inner surface, and the interface between vitrified furnace material and slag is generally not

macroscopically visible. The furnace is about 80 cm tall, and has a diameter of 25 cm at the bottom. A layer of 10 mm slag in the lower 30 cm of the furnace would amount approximately 2.25 l of slag. With a mean density of 2.7 kg/l, the slag mass of this is about 6 kg. Thus, most of the expected slag is accounted for, and it should be kept in mind, that the slag we collect from archaeological excavations, even if we can account for all individual slag pieces, does not equal the amount of slag that was produced in the process. In our case, we seen that two thirds of the slag were lost by sticking the furnace walls.

The research focus on these early stages of iron technology is not so much on questions regardig rentabilty related questions as much more on iron production itself, such as questions of carbon uptake or the potential selection of carburized section of blooms. A pivotal question is to determine if the occurrence of carbon-containing steel in blooms was accidental, inevitable, or a result of intentional processes.

Metallography. A short and incomplete introduction to steel constituents

It is far beyond the scope of this paper to explain the many constituents of the steel grain structures. However, the constituents described following are the most common ones. Constituents can be phases or mixed phases. To make matters clearer, in material science phases are the artificial, or rather man-made pendants to naturally occurring minerals. Sometimes there are mixed phases that consist of two intergrown phases. The grain structures that are identified by metallographical means are made up of grains and nodules. The term grain is reserved for single phase constituents, if the constituent consists of a mixes phases, the term nodule is used.

Austenite, or -iron, is the name of the crystal structure of iron at a temperature approximately above 723 °C and below 1394 °C. It is present in a so called fcc - for face centred cubic - unit cell. Carbon is in complete solid solution in austenite.

Ferrite, or α–iron, is in metallurgical terms a phase, and an "artificial, i.e. man-made mineral". It is almost pure iron. Its bcc – Body centred cubic – unit cell and can dissolve only 0.005% carbon at room temperature (Branning and Lawrence 2004). It is very soft and it appears as white phase in the micrographs. They do appear in three morphologies:

1. Equi-axed ferrite – typically in normalised and slowly cooled low carbon steels.

2. Pro-eutectoid ferrite, forming along former austenite grains.

3. Allotriomorphs or acicular ferrite forms also on the grain boundaries of former austenite grains, but this ferrite grows further into the grains in a needlelike fashion.

Cementite, or iron carbide is also a phase, moreover is a chemical compound with the chemical formula Fe_3C, and thus contains 25 atom% carbon, which equals 6.67 mass% carbon. It is extremely hard and brittle..

Pearlite is a constituent that is not a single phase, it consists of two layered phases: ferrite and cementite. Pearlite contains always 0.77 mass% carbon; it is in fact of eutectoid composition. If there is more carbon in the steel it is present in additional cementite grains, if there is less carbon the grain structure shows pearlite and ferrite grains.

Bainite is also a constituent that is composed of two phases, and it is also composed of ferrite and cementite. The difference is in its appearance. It is not a layered structure such as pearlite, but can appear in many different forms. It is also sometimes very difficult to differentiate from martensite by metallographic means. It describes many different morphologies "in-between" the formation of martensite on the one hand and pearlite on the other hand. It is formed by faster cooling rates than pearlite, but slower cooling rates than are necessary for the formation of martensite.

Martensite is a grain structure that has been cooled, i.e. quenched so rapidly, that the carbon that was in in solid solution in the austenite grains had no time to diffuse to form either ferrite or cementite. It is present in the bct - body centred tetragonal - unit cell. Martensite is very hard and brittle, because the forcibly dissolved carbon atoms deform the crystal lattice. The deformation of the crystal lattice is responsible for the hardness of the resulting metal. It can also not be plastically deformed, since the material responds with breakage. There is no typical carbon concentration in martensite, because in theory it can incorporate any concentration from 0-1.3 mass% or so (Liedtke and Jönsson 1996). In practical terms, it contains carbon from up to 0.15 mass%, because the low critical cooling rate (CCR) is too short to be applicable in a workshop environment (Jones and Ashby 2012).

A eutectoid reaction is a three-phase reaction by which, upon cooling, one solid phase transforms into two solid phases at the same time. If the bottom of a single-phase solid field closes (and provided the adjacent two-phase fields are also solid), it does so with a eutectoid point (Jones and Ashby 2012, 73). Be aware that the literature provides values for the eutectoid composition of 0.77 mass% and 0.8 mass% carbon.

Hypo-eutectoid steels are steels that possess a carbon content below the eutectoid composition. Hyper-eutectoid steels contain more carbon than that of the eutectoid composition.

Pro-eutectoid constituents are those that formed before the eutectoid composition was reached during cooling. For the purposes of this paper this is usually ferrite.

Of tremendous help is the iron carbon phase diagram, that displays the phase formation processes under equilib-

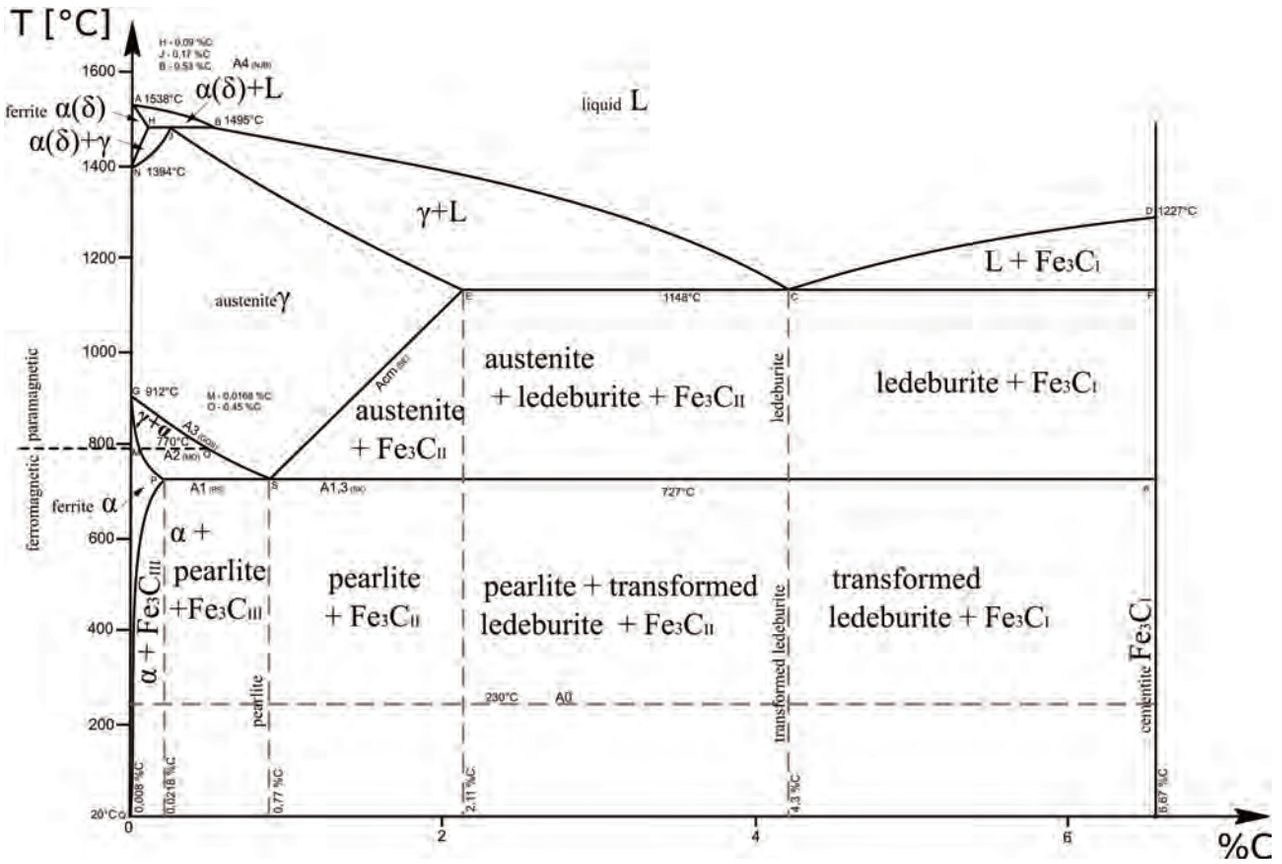


Figure 5: The iron carbon phase diagram is used to map and understand the phase transformations in this alloy. It is for equilibrium states only, so it cannot inform us on heat treatment processes.

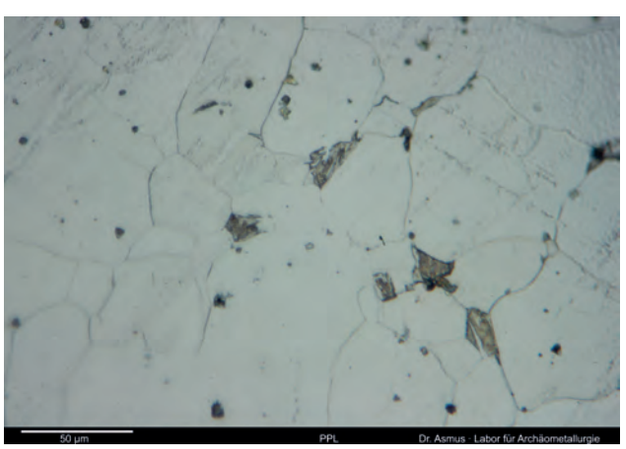


Figure 6: Etched 2% Nital. Image width 275 μm. Higher magnification of a region with very little carbon content. This is almost pure ferrite, situated towards the edges of the sample. Image: © B. Asmus.

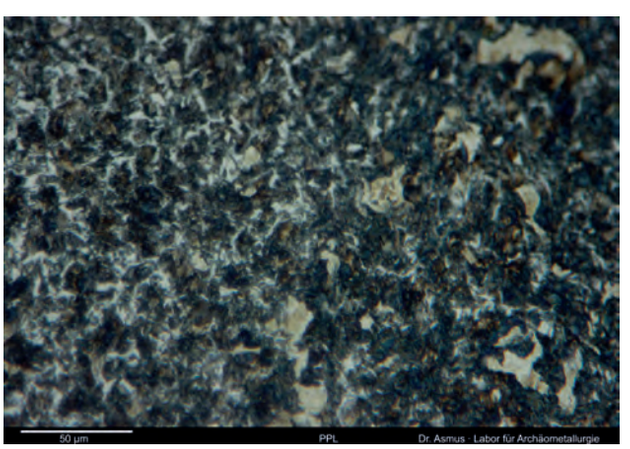


Figure 7: Etched 2% Nital. Image width 275 μm. Higher magnification of a region with an almost pure pearlitic composition, i.e. very close to the eutectoid point of 0.77 mass% carbon. Image: © B. Asmus.

rium conditions (Figure 5). Of concern for the purposes of this paper is the left hand side of the diagram up the eutectoid point, labelled with the letter S. It tells us that steel with a composition between 0.02 mass% and 0.77 mass% will form grains of ferrite (Figure 6), and that all the present carbon is used to form a phase mix of ferrite and cementite called pearlite. The resulting microstructure thus has ferrite grains and pearlite nodules, as for example shown in Figure 7.

Bloom

After the last ore charge the full charcoal stack was allowed to burn down for approximately 1.5 h. The bloom (Figure 8) was cooled rapidly in water after its extraction from the furnace. There were about five minutes between opening and cooling the bloom in water. This will have some importance for the discussion of the observed microstructures.

Figure 8: Weighing of the resulting experimental bloom. Note the typical spongy appearance, with the porosity filled with all sorts of melting slags. Image: © B. Asmus.

Bloom of iron or steel?

This bloom is heterogeneous and exhibits varying degrees of carbon. Throughout the sample however the carbon contents never reaches the eutectoid point of 0.77 mass% C. The carbon content is usually much lower, as will be demonstrated in the following metallographic images.

Where the slag is concerned, the process can be regarded as a textbook bloomery process. The yielded bloom was sectioned and prepared for metallographic analysis. The resulting micrographs (Figure 9) shows a plain polarised light micrograph, prior to etching in order to characterise the texture the bloom, and to establish the quantity, as well as the dimensions of slag inclusions in the bloom. Slag inclusions in the analysed sample of the bloom tend to be small with an estimated average mean dimension of 50 μm. The bloom consists of fairly clean metal, is however of a spongy character which can be seen towards the bottom of the micrograph. These surface blemishes are in fact unfused iron grains. This does become clearer in the micrographs that were etched with 2% Nital solution.

Figure 10 shows a section of the grain structure of the bloom, which is mostly ferritic. It contains little to no carbon. The grain size can be seen clearly and varies in size between 0.2 mm and approximately 1 mm. There is also a lot of porosity visible in this image, which is filled by epoxy resin appearing of dark grey colour.

Figure 11 shows a bainitic grain structure. To put it simple, bainitic structures develop as intermediate structures when carbon steels are cooling too slow to form martensite, but too fast to form pearlite (Bhadeshia 2015). Bainite is only a term that describes the appearance of a grain structure, just like pearlite does. Bainite is also made up

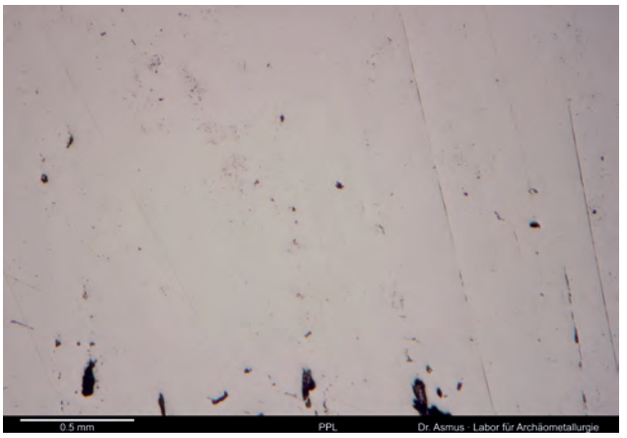


Figure 9: Image width: 2.7 mm. PPL. The section shows a polished section of unrefined bloom. There are a few small slag inclusions. Porosity at the bottom is along incompletely fused iron grains. Image: © B. Asmus.

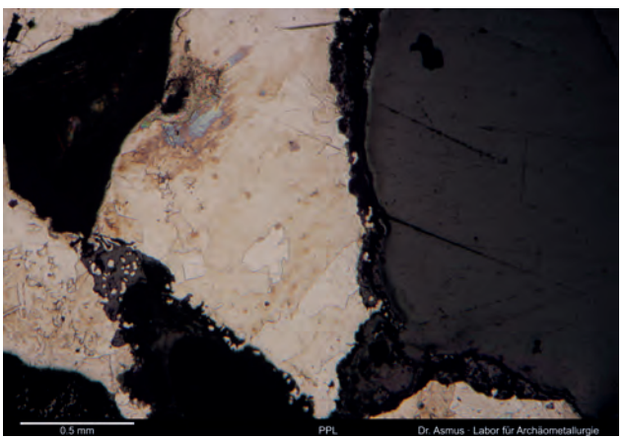


Figure 10: Polished section of bloom. Hardly slag inclusions. Only partly fused along the grain boundaries, this section display this a elongated pores at the bottom. Image: © B. Asmus.

Figure 11: Bloom, etched cross section with 2% Nital solution. Bainite, a structure formed when cooling low carbon steels not fast enough to form martensite, but faster than to form pearlite. Image: © B. Asmus.

from ferrite and cementite, but follows other formation processes.

Since this is an archaeological paper it suffices, to know that is particular structure is called Widmanstätten structure that forms from primary ferrite (Figure 12), upon cool-

Figure 12: Bloom, Widmanstätten ferrite, is found throughout the heterogeneous sample, making this a low carbon steel. These structures do not develop near the eutectoid point. Image: © B. Asmus.

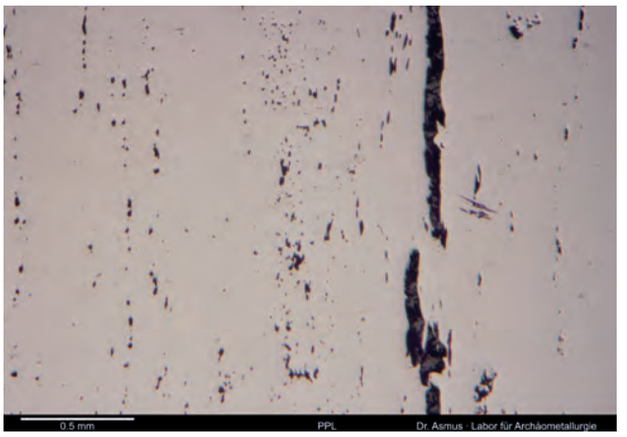


Figure 13: The layered structure of the steel is unmistakable. The slage stringers are aligned along the direction of the fire-welded areas. The structure has no improperly welded areas. Quite contrary to the bloom. Image: © B. Asmus.

ing at rates which are too fast for pearlite formation, but slower than those for the martensite formation. This type of ferrite can only form from hypo-eutectoid, i.e. not more close to the eutectoid point of 0.77 mass% carbon compositions. Looking at the experimental observations, we recall that this bloom had cooled for five minutes in the air before it was quenched in water. The bainitic structure is therefore an expected grain structure for the bloom.

The Widmanstätten ferrite is also observed elsewhere in the bloom and these are the parts with the highest carbon contents in the whole sample. Depending on the representativeness of the sample for the whole bloom as well as the heterogeneous composition of this sample, it is reasonable to assume that the whole bloom does possesses carbon contents of a bit less than 0.4 mass% carbon, probably mainly around 0.2 to 0.3 mass% C, which would produce steel that is barely hardenable, or not hardenable at all without further treatment, such as an intentional carburisation process, for which there is currently no archaeological evidence.

The bloom is rather heterogeneous in its appearance and future research might investigate the diffusion rates, by mapping the complete blooms carbon content - rather than small samples - making a special interest in its position in the furnace in relation to its position of the tuyères.

Consolidated metal samples

Three further samples were prepared for metallographic analysis and are used to directly compare these with the chisel from Rocha do Vigio. all samples stem from the same consolidated bloom that was analysed above. They were forged and fire-welded by Thomas Mink (see this volume) using a modern forge.

The samples' thickness is about 2.5 mm, the width 8.5 mm and the length some 18 mm. One sample was prepared from the untreated steel, the other two were heat treated,

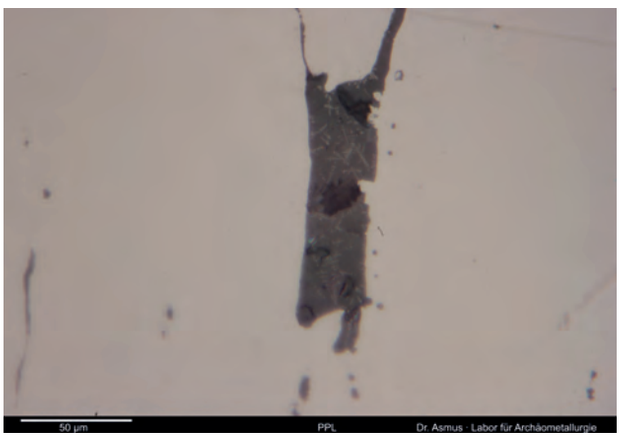


Figure 14: High magnification of a larger slag inclusion within the weld: Wüstite dendrites within the slag. Image: © B. Asmus.

in order to harden them. The second sample was quenched from a light red hot state, i.e. ca 870 °C in water. The piece was not tempered, but left in a supposed as hard and brittle as possible state, to examine the expected maximum extent of the martensitic transformation. Directly after quenching, the sample was tested with a file. Hardened steel is usually not scratched by a file. This sample however could be worked with a file. At this stage of sampling the low carbon contents of the bloom was not known, and the austenitisation temperature may have been too low, as will be shown in the metallographic images. In the following, the metallographic analyses of the untreated and heat treated refined steel samples are presented. Both samples were studied under plain polarised light prior to etching with 2% Nital solution. For this reason, a third sample was prepared and quenched from an orange state, i.e. approximately 950 °C, and analysed metallographically.

The polished section of the untreated steel shows parallel lines of slag inclusions trough out its cross section (Figure 13). There is no porosity and there are welding mistakes in the samples. Slag inclusions range in shape from bands

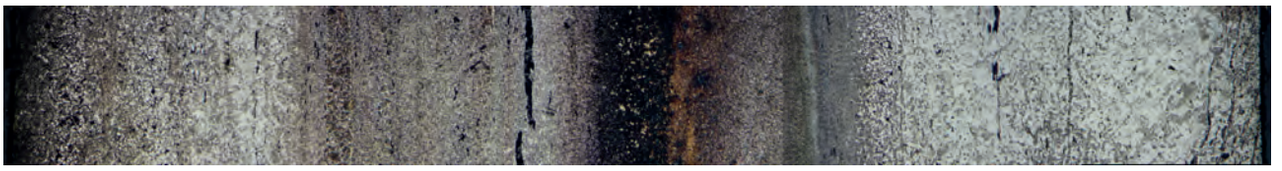
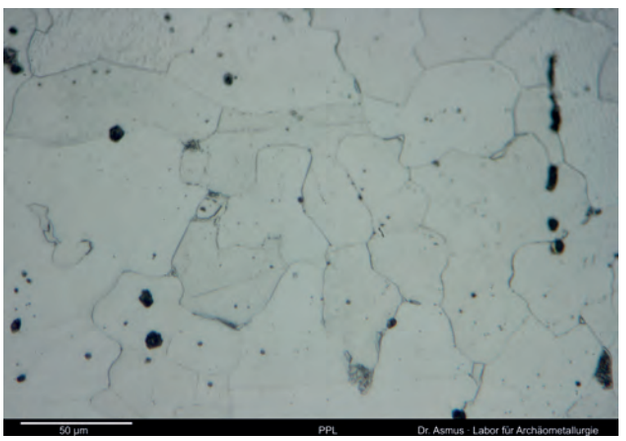


Figure 15: A composite of six micrographs. Total width of the sample is 8.5 mm. Etched Nital 2%. Note the very heterogeneous layered composition. The highest carbon content is in the centre, where the steel has a eutectoid composition. The largest part of the sample has a much lower low carbon content, with areas of almost pure ferritic composition. Image: © B. Asmus.



Figuren 16: Heat treated sample, etched 2% Nital. More or less pure ferrite. The critical cooling rate was exceeded, otherwise there would be no ferrite. Image: © B. Asmus.

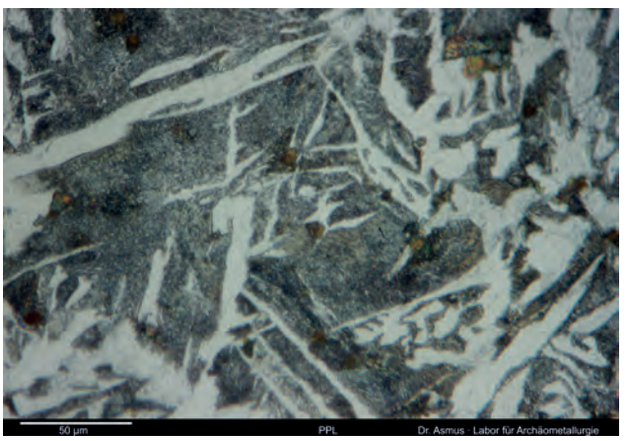


Figure 17: Heat treated experimental steel sample. Etched 2% Nital. The constituents are allotriomorphic ferrite, that grew along the former austenite grains, as well as fine grained pearlite and bainite. No martensite was encountered in the whole sample. Image: © B. Asmus.

of up 30 m thickness to round inclusions of only a few microns in diameter. They are very clearly situated along the weld lines of the sample.

Figure 14 shows a slag inclusion within the steel at higher magnification. The wüstite dendrites can be clearly seen in the glassy or sub-microscopical matrix.

The etched sample shows the expected pearlite nodules and ferrite grains to be present throughout the sample. The layered structure can be seen in Figure 15, a composite of 6 micrographic images. The phase composition is very heterogeneous and ranges from almost pure ferrite (see Figure 16) to almost exclusive pearlite (see Figure 7). The only region that is expected to be hardenable is situated in the centre of the sample, which is almost certainly a result of the heterogeneous bloom. It proves that mid to high carbon steels were in principle achievable in the bloomery process, but it also shows that it was rather unpredictable where these parts ended up in the produced consolidated piece of steel. There is theoretically the possibility that the regions towards the rim were decarburised during the forging process, however it seems unlikely, because the bar was produced by a highly experienced blacksmith, who is fully aware of the different oxygen fugacities, which are the oxidising, neutral and carburising zone within the forging hearth.

The heat treated sample was meant to be hardened, however looking at the metallographic analyses it was not hardenable. This apparent failure from the pragmatically oriented crafts perspective, provides however a perfect opportunity to look a little bit deeper into the hardening process, and provides a hypothesis as to which processes led to the failure. Before doing so, two metallographic images are presented that show that there is none of the expected martensite present.

Figure 16 presents a grain structure that should not exist in a fully hardened sample. The pure ferrite grains can only form under certain conditions: first, there is no carbon in the austenite, or second, the critical cooling rate was exceeded and as a result there was enough time to form several phases by diffusive processes. Looking at the sample that has not been heat treated, we can conclude that there was no carbon in certain regions of the sample. Further we can deduce that the austenitisation time was not sufficient to diffuse all carbon equally throughout the sample. These processes can explain the grain structure sufficiently.

Allotriomorphic ferrite and dark and very fine grained bainite and pearlite can be seen in Figure 17. This sample was quenched from ca 870 °C in water, furthermore its dimensions are small. In other words, all the parameters to produce martensite in a medium carbon steel were met, however the grain structure did not undergo a martensitic transformation, instead allotriomorphic ferrite formed next to very fine grained pearlite and bainite.

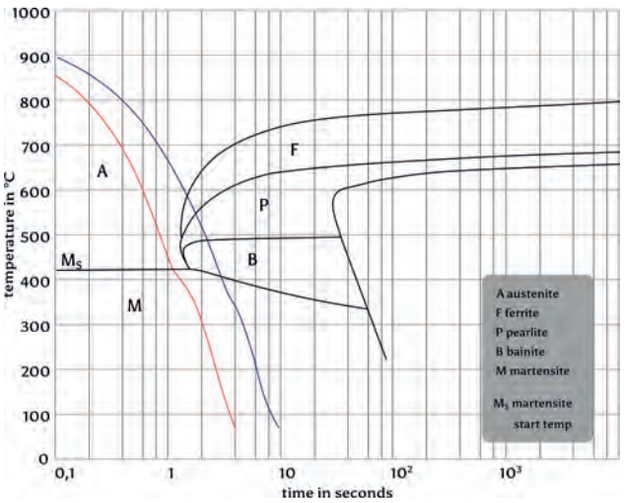


Figure 18: Continuous Cooling Transformation or CCT diagram for a low alloy steel with 0.3 mass% carbon. Blue and red lines are cooling rates. The red line is below the critical cooling rate. The blue line exceeds the critical cooling rate. The blue cooling rate applies to the heat treated sample in this paper. Modified after Rose and Hougardy 1972.

As laid out above the phase diagram cannot be used to glean information on the heat treatment of steel. There is however another type diagram that was designed for this purpose: The continuous cooling transformation (CCT) diagrams allow to develop hardening cycles, by determining the critical cooling rate (CCR), that is the maximum time interval that allows for a transformation from the austenite to martensite. As a general rule, the CCR increases with the carbon content of the steel, and can be further modified by additional alloying elements. This is one the reasons for the ample amount of modern steel alloys for all particular purposes. Without going into too much detail here, Figure 18 shows a CCT diagram for a low alloy steel: a 0.15 mass% carbon steel, that was carburised to 0.3 mass% (Rose and Hougardy 1972, 27). Of importance are the cooling rates, signified here as red and blue lines. The red line signifies fast enough cooling, i.e. within the critical cooling rate for this steel and carbon content: The martensitic transformation takes place. The blue line exceeds the CCR, i.e. it is slower than necessary for the martensitic transformation for this steel and carbon content. As a result, those grain structures the line crosses are to be expected within the sample. In this case ferrite, pearlite and bainite can form, but no martensite. The sample, as laid out about above, exhibits only ferrite, bainite, and pearlite.

The third sample was quenched from a higher temperature in order to austenitise the complete sample. Form the Fe-C phase diagram (figure 5) it becomes clear a low carbon alloy steel with 0.3 mass% C is completely austenitised above 912 °C, whereas it was not at 870 °C, as above in the first heat treated sample. After this complete austenitisation process the sample was quenched in water below the critical cooling rate, to avoid creating bainitic grain structures. As a result, the whole sample shows various martensite structures (Figure 19).

The top left image shows various martensitic structures. Even the almost pure ferritic regions underwent the martensitic transformation (Figure 19, top right). This was only possible because of the small dimensions of the sample, i.e. the innermost parts of the specimen were also cooled below the CCR. In a real world scenario with a chisel and its larger dimensions, the ferrite would not have undergone this transformation.

The bottom left and right images show martensites with approximately 0.3 mass% carbon. They are present as lath martensite, which is typical for low carbon steels. The sample reminds us, that the martensite does not possess a specific carbon content, such as for example the pearlite constituent, but that is a sole morphological classification, that tells that the iron lattice did not have enough time to transform to the cubic body centred, but has transformed into the body centred tetragonal lattice. It also shows why hardness testing of martensitic structures area especially insightful, as they allow us to classify a steel sample directly as hard or soft.

Comparison of Rocha do Vigio and the experimentally smelted steel

The Rocha do Vigio chisel possesses areas with near eutectoid, that is pearlitic, composition, with an estimated carbon content of close to 0.77 mass% (Figure 20). There is also a rather large slag inclusion in this section, that has potential to be analysed chemically by electron microprobe analysis.

The material of the chisel from Rocha do Vigio differs from the experimentally produced steel in its bulk chemical carbon content, although both materials are heterogeneous. The highest carbon content in Rocha do Vigio is seen in Figure 20, in the areas with almost pure pearlitic composition. The lowest carbon content in this chisel is seen in Figure 21. It is rather higher than in the experimentally produced samples, as there are much more pearlite nodules in between the ferrite grains (e.g. Figure 16).

The areas of low carbon contents in the experimentally smelted steel are both higher in proportion to the high carbon content areas, and also lower in their total carbon content than those in the chisel. The resulting carbon content of the experimental steel is thus low altogether, and although quantitatively very difficult to assess, it is believed to be around 0.2 mass% carbon altogether. This is partly deduced from the poor hardening results of the sample: the sample did not undergo a martensitic transformation, but produced a bainitic grain structures. It may be concluded that the critical cooling rate was exceeded.

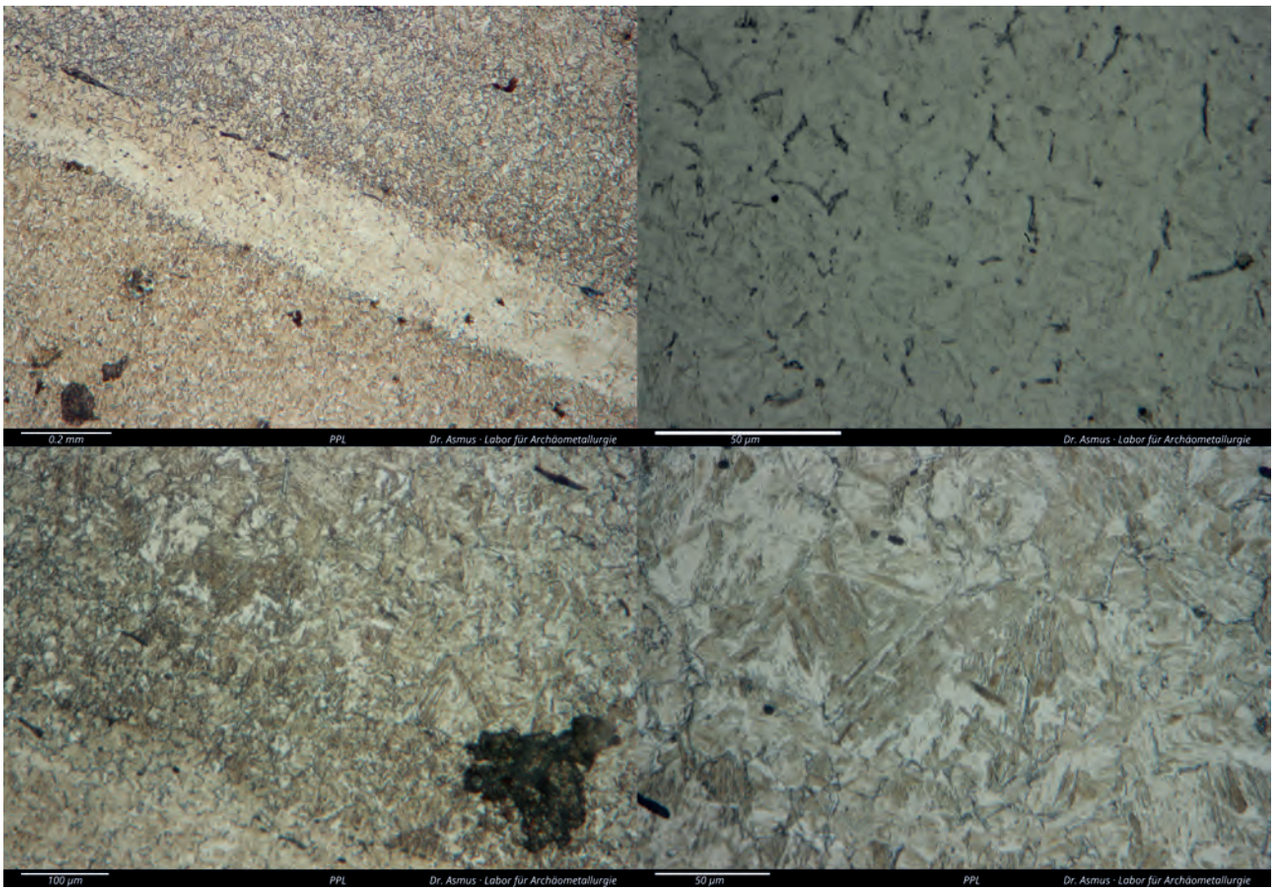


Figure 19: The second heat treated sample. It shows martensite, as predicted from the CCT diagram. Etched with Nital 2%. PPL. Top left: Overview of various martensitic structures. The lightly coloured area is a layer of ferrite with a very low carbon content. Top right: Even the mostly ferritic areas underwent martensitic transformation. Bottom left: Martensite in an area of the sample with carbon content of about 0.3 mass% C. Bottom right: Lath martensite at higher magnification. Image: © B. Asmus.

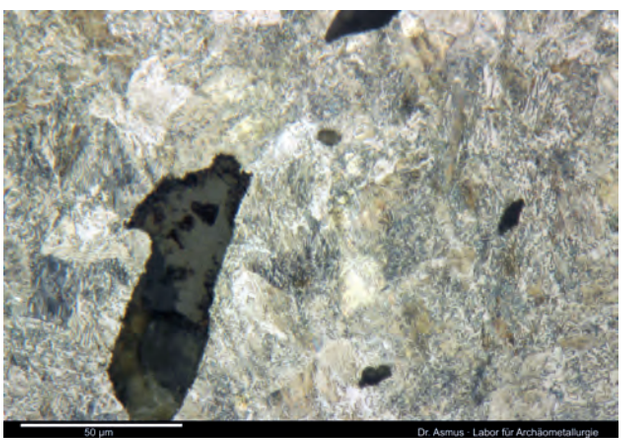


Figure 20: Steel chisel from Rocha do Vigio, etched 2% Nital. This section shows a near eutectoid composition. There is almost only pearlite. Also there is a large slag inclusion. This section represents those regions of the chisel with the highest carbon content. Image: © B. Asmus.

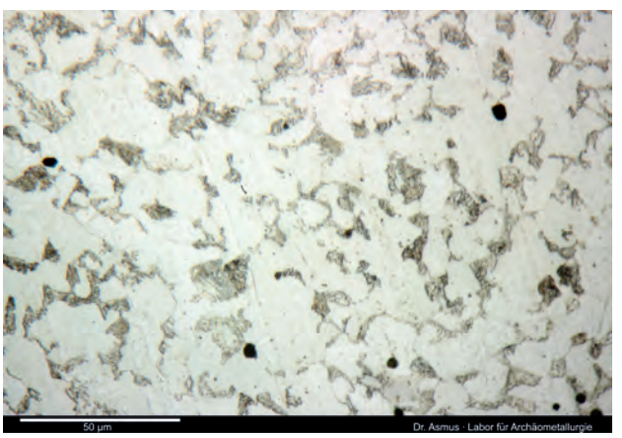


Figure 21: Steel chisel from Rocha do Vigio, etched 2% Nital. This area consists mostly of ferrite grains and some pearlite nodules. This represents the areas with the lowest carbon content of the chisel. Image: © B. Asmus.

The blacksmiths of the chisel from Rocha do Vigio used a steel with a higher carbon content and a smaller variability in its heterogeneity. The steel was less refined by fire welding. To understand whether or not and to which degree this reflects intentionality is a desideratum that needs to be explored in future studies.

Discovering hardening

The chisel of Rocha do Vigio was sampled at its distal end. Martensite, and thus hardening could not be shown from a material point of view. As to whether the tip was hardened will be examined in a future study. Independent of

the question as to whether this chisel was hardened or not, the author would like to put forward the following hypothesis: The people of the late bronze age possessed metallurgical skills and experience with the non-ferrous metal for at least a millennium. The processes that led to optimal bronze tools and weapons were clearly mastered from a crafts perspective (Bottaini 2012). To reiterate, to produce hardened bronze tools it is necessary to work harden this material by cold hammering. Intermittent annealing cycles release the stresses induced in these materials and enable the metal worker to continue working, without breaking it.

Then, a new metallic material was introduced into these communities. Would it be so alien to think that these well versed metal workers try this new material in all the ways they know from working bronze?

1. Casting: does not work.

2. Cold hammering: does work, it even work-hardens iron to some degree.

3. Annealing: does work, when cooled slowly, but results in significant increases of hardness when cooled faster

The installations for heat treating were already in existence and the experience how to treat bronze to produce objects with superior properties was in existence, thus the insight that mechanical properties of a metal could be manipulated was given. Then iron with a significant amount of carbon becomes known to these communities. It does not take a lot of chance that an increase in hardness would be discovered as soon as all these requisites are met. This is not to say that the optimum hardness was achieved in the minute steel made its way into these communities. Currently, our knowledge of this critical point, or rather these critical points in history – and surely this observation was made many times, in many regions of the world – is far too limited, and it would be foolish to think of a linear development of iron and steel technology. But with the chisel from Rocha do Vigio, we might grasp a moment in human history where this pivotal step in technology might just have happened, or was at the very least imminent.

Conclusions

The slag produced from this experiment was well suited for the bloomery process and enabled the iron to separate easily from the slag. Mass balancing has shown that for a single smelting event the tap slags mass does not reflect the mass of slag produced. On the contrary, two thirds of the slag remained fused to the furnace wall, and hence remain elusive to mass balancing efforts. The unrefined ore to finished iron metal ratio is about 5:1.

The bloom shows varying degrees of carbon content from almost pure iron to small regions with up to eutectoid composition, i.e. a carbon content of 0.77 mass%. Further studies of experimentally produced bloom are necessary to map the diffusion of carbon into the bloom.

The structure of the sample will certainly result in a tool that will be not sufficiently hardenable as a whole, however the pearlitic part in the centre shows without a doubt that carbon steel is attainable from the bloomery process. Contrary to the chisel from Rocha do Vigio, the experimentally produced steels shows clear signs of numerous fire welding and folding processes, with a number beyond that of the archaeological steel. Furthermore, the variation in the carbon content of the archaeological sample is smaller than in the experimentally produced sample. However, the absolutely attained carbon content in some parts of the experimental bloom, respectively the bar iron, is very similar or same. The archaeological sample of Rocha do Vigio has an overall higher carbon content, which made it more likely to be successfully hardened, not only in terms of achievable hardness, but also in terms of practicability. In contrast, low carbon steels possess a very short critical cooling rate, which impedes successful hardening in a workshop environment. This was also encountered also during the preparation of the "hardened" sample.

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CHAPTER 15

Bodies, representations and time. Anthropomorphism in Iberian late prehistoric art: from portable objects to stelae and statue-menhirs

Ana Amor Santos

Abstract

The archaeology of the Iberian Peninsula is rich in examples of pre- and protohistoric anthropomorphic representations. The aesthetics, materials, morphologies and even meanings have changed and shifted through and with time, and these processes have seldom been studied holistically. In this preliminary study, we will illustrate how a long diachronic approach centred on anthropomorphism and bodily representations, favours and allows for other readings of past social change, creating space for new interpretative queries. This will be done through 1) an overview of the represented body in portable objects from the Neolithic to the Iron Age, and 2) integrating the anthropomorphism of protohistoric stelae and statues-menhir in this long-chronology view.

Keywords: body representation; anthropomorphism; portable objects; stelae and statue-menhirs; long diachrony; Iberian Peninsula

Resumo

A arqueologia da Península Ibérica é rica em exemplos de representações antropomórficas Pré e Proto-históricas. Os fatores estéticos, materiais, morfológicos e até os significados foram mudando e alterando-se ao longo e com o tempo, e estes processos não são frequentemente estudados de forma holística. Neste estudo preliminar, iremos ilustrar como uma abordagem na longa diacronia centrada no antropomorfismo e nas representações corpóreas, favorece e permite novas leituras de mudanças sociais passadas, criando espaço para novas questões interpretativas. Tal será feito através de 1) uma vista de conjunto do corpo representado em objetos móveis do Neolítico à Idade do Ferro, e 2) integrando o antropomorfismo das estelas e estátuas-menires proto-históricas nesta leitura na longa diacronia.

Palavras-chave: representação do corpo; antropomorfismo; estelas e estátuas-menires; longa diacronia; Península Ibérica

1. Introduction

The act of giving human form to materiality eases our understanding of the world around us. As human beings, anthropomorphising things, animals and plants happens for many reasons, but perhaps most of all because the human form is the one we know best. In the pre and protohistoric archaeological record of the Iberian Peninsula there are many examples of representations of the human body, from Palaeolithic rock art to Iron Age *ex-votos*, that in all their aesthetic, material, contextual and geographical variability mirror the need for depicting the human body (or something that resembles it).

In this text, we will briefly cover how anthropomorphism and the representations of the human body have changed through (and with) time during Late Prehistory

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in the Iberian Peninsula from the Neolithic to the Iron Age. We will focus on portable objects and anthropomorphic statues-menhir and stelae, integrating the latter in our previously developed long diachrony approach to human representations in late prehistoric portable art (Amor Santos 2025; Amor Santos 2020), as leading examples of anthropomorphism in less movable artforms.

We will refrain from debating other representations of the human body from this chronological timeframe, such as rock art (e.g. Sanches, Morais and Teixeira, 2016) and the immense Iron Age assemblages of exogenous influence (e.g. Maestro, 1989), among other extensively debated subjects – even though they, too, play a crucial role in understanding human representations and, consequently late prehistoric art.

Through the lens of the Archaeology of the Body and focusing on the anthropomorphism of representations, the aim of this paper is to outline how the human body was represented and how such representations changed throughout the course of 5 to 6 millennia in the Iberian Peninsula. This, in turn, highlights how the long diachronic view of such data contributes to the understanding of different *body worlds* (Harris and Robb 2013) in Late Prehistory. This paper aims to present an introductory overview of anthropomorphic representation in portable objects and stelae (and statue-menhirs) in a preliminary approach, as fuel for future discussion[1].

2. Body and time: a theoretical and methodological framework

Researching the representation of the human body in a large span of time, particularly in such a comprehensive and extensive way, is quite a challenging endeavour. Drawing from our previous research (Amor Santos, 2025; Amor Santos 2020), this paper adds new layers and depth by tackling anthropomorphic supports of less mobility, the statue-menhirs and stelae. Even though these could be (and most certainly were) moved, their relation to the territory and landscape and, by extension, with people and "real" human bodies, were far different from the relationships between small portable objects that could be carried and manipulated in higher rates and closeness to "real" bodies.

In order to understand the processes of change in human body representation throughout Pre and Protohistory in the Iberian Peninsula, we applied the '*body world*' model and ontology (Harris and Robb 2013) for the very first time to this geographical area from the Neolithic to the Iron Age, relating to portable objects never previously analysed together. The research presented in our master thesis (Amor Santos 2020) offers the first attempt to adapt this model on a smaller scale than the original work, which spanned from the Palaeolithic to the present day in Europe (Harris and Robb 2013). The only other adaptation of it in our knowledge was done by Marianne Hem Eriksen (2022) with a case study of two late prehistoric Scandinavian objects.

The *body world* practical ontology developed by John Robb and Oliver Harris (2013) carries multiple perspectives on the body, incorporating the totality of experiences, practices and body representations in a particular time and space, central to the way the world is understood. This means that, for every human being, the *body worlds* are the worlds in which we all inhabit simultaneously, and these worlds are both specific and culturally diverse (Harris and Robb 2013, 4).

The human body is always ontologically multimodal in the sense that humans understand and experience it in accordance with multiple sets of foundational principles that come into play in different circumstances that may even create and exist in tension (Harris and Robb 2012, 676). Therefore, these are always simultaneously social, cultural and material (*idem*).

The concept of *body world* encapsulates the notion that, regardless of the time period, to understand the body, we need to understand its cultural, social, political and material frame of reference – even if this bodily material frame of reference is always complex, sometimes even contradictory. The bodily material frame of reference is also historical, because bodies are themselves historical agents, embodying and constructing understandings of the world, even if unconsciously (Harris and Robb 2013). Historically, then, there is not a unique corporeal construction (a single body) that is understood in different ways at different points in time, but rather many different bodies that are intimately socially and biologically different (Harris and Robb 2013, 16).

The *body world* model emerges following growing theorisation around the body in Archaeology, Anthropology and other sciences, and is thus influenced by a multitude of multidisciplinary concepts and frameworks – namely, *habitus* by Bourdieu (2002), *taskspace* by Ingold (2000), and *power* by Foucault (1975).

Consequently, so is our research, with great focus on the Archaeology of the Body, a theoretical branch developed from the 1990s onwards that became more widespread during the first decade of the current millennium (Joyce 2005; Moragón Martínez 2013). Here, the body is understood as a space of lived experiences, a social space and one of embodied agency – drawing from concepts of *embodiment* (Csordas 1997), *agency* (Latour 1996), and

[1] This topic will be further developed in our ongoing PhD project.

phenomenological approaches (Merleau-Ponty 2012, in relation to Bourdieu 2002). The Archaeology of the Body, itself inspired by many sociological and anthropological theories of the last decades of the 20th century (namely "feminist theory"), emphasises the necessity of analysing the past body through the juxtaposition of traces of bodily practices, representations of the body and evidence of the effects of gestures and usual consumption practices on the body (Joyce 2005, 140-141).

Our research is embedded in all these theoretical frameworks, aiming at tackling body representations, as explained elsewhere (Amor Santos, 2025). To sum up, by focusing on the represented body (its aesthetics and the objects, materials and contexts in which it occurs), we can contribute to an Archaeology of the Body, and by adapting the *body world* model it is possible to analyse multiple categories of objects and representations from the 6th/5th millennium BCE and the 1st millennium BCE, and the enormous territorial scale that is the Iberian Peninsula.

In practical terms, in order to have certain perspectives build upon others, our analysis usually works on multiple scales, in the sense that there is a reduced focus when analysing the representations themselves, the objects in which they occur and their contexts, even though the goal remains that of having the big picture, allowing the identification of different patterns and processes. When analysing the statue-menhirs and stelae, we will draw a few examples from the immense literature on the subject, despite not delving into topics such as the "idol-stelae" and "diadem-stelae" ("*estelas diademadas*").

3. Anthropomorphism and representations

Studying all the layers of late prehistoric art is crucial to try to understand the people who made, used, lived with and discarded the representations or the objects in which they occur. It is particularly important when considering that, as far as we know, people had no writing systems for the greater extent of our scope of analysis. This paper covers briefly only a few of those layers, relating to the anthropomorphic representation in portable objects, in statues-menhir and stelae, and should be seen as a first step in a wider study.

Anthropomorphism is the act of giving human form to objects or of depicting the human body. The representation of the body is, here, understood as the bi- or three-dimensional reproduction of the body by means of altering, shaping, modelling, carving, inscribing or decorating different raw materials. We distinguish between "full-body" representations, when most of the human body's features are present, and "partial-body" representations, when only certain body parts are represented.

Representation is a unique tool for the study of past bodies because it is a technology through which people mirror some important cultural features, even if this process is not always conscious or intentional. When representing the body, what are considered to be the most important attributes are emphasised and what is not deemed relevant to the craftsman (and/or for who "commissions" the work) is omitted, in any given time and space.

Even though we do not intend to delve into the possible meanings of late prehistoric Iberian body representations, some authors have noted that representations are part of the material culture in which concepts of *embodiment* become natural (Joyce 2005, 147). Another perspective points to figurative representations as translating political and religious characters, whose meaning is rooted in what they represent and in the very object they are part of; the figurative representation of the body, then, entails a double meaning: that of the object and that of the represented 'symbol' (Escoriza-Mateu and Castro-Martínez 2011, 102). While valid to some extent, these interpretative theories should not be applied generically to all of Late Prehistory in the Iberian Peninsula, because they disseminate ideas that can be proven to be fallacious.

When analysing the ways in which the human body was depicted in different regions of the Iberian Peninsula throughout and within the Neolithic, the Chalcolithic, the Bronze and Iron Ages, the variability of representations and aesthetic rules (when these can be argued for) is striking. Bearing in mind the great geographic and chronological scale of analysis, it should be taken into account that this variability reflects the great differences in the social, political and historical context of each time period and community.

The study of figurative representations has traditionally (and many times arbitrarily) assumed that they constitute direct ways of recognising what past people thought, including the assumption of the exact meanings of such representations (Escoriza-Mateu and Castro-Martínez 2011, 101-102). In turn, regarding particular motifs and aesthetics, this generated axioms regarding late prehistoric representations that despite the lack of clear archaeological data, remain to this day hard to dismantle (e.g. the "mother-goddess" interpretation for Chalcolithic anthropomorphic representations, cf. Amor Santos, 2025; Vale 2015; Coltofean-Arizancu, Gardarska, and Mati 2021).

We argue, then, that this variability should be considered for what it is: an empirical fact. And even though we consider body representation a discursive element, however unconscious, that integrates and expresses corporeal life, the representation's meaning should not be seen as limited. Just as the *body world* concept itself, it allows

contradictions, individual expression and divergencies in the same time and space. This means, then, that any causation proposed for the differences in body representation is itself the result of many other historical, cultural, social and political processes (Robb, 2009: 163), which is why representations should always be taken into account regarding their context.

Furthermore, this variability enforces interpretative proposals of body representations to consider multiple options and, in our view, to discard single justifications for multiple and distinct realities over such a vast amount of time and space.

4. Brief overview of the anthropomorphism in late prehistoric objects

The moments of cultural transition inflect upon the bodily representations in portable objects (Harris and Robb 2013). In fact, they essentially match the transformation phases in the aesthetic treatment of the represented bodies. Although the changes in body representation could result from multiple factors (many of which we do not yet understand and would certainly be different from case to case), they could derive from the way the perception of the body, in these moments of transition, was also experiencing change.

These transitions are clear in the focus the Neolithic body representations in portable art tend to give to whole body depictions, although generally without details such as eyes, noses, or mouths. During this time, in the Iberian Peninsula and unlike what occurs in central Europe, anthropomorphs in pottery decorations are not common in terms of quantity. In many cases, they were found in caves, as occurs in Cova de l'Or (Alicante, Spain) (Marti and Hernández, 1988) and from Cova de la Sarsa (Valencia, Spain) (Perez Botí, 2001). Here, there is clearly a concern with the central part of the body. Despite being schematic, some anthropomorphic representations have upper and lower limbs, sometimes even fingers, and heads (Fig. 1-A).

The lack of individualised body markers and the schematism of the representations during this time, could relate to a "new" human-animal relation associated with the process of sedentarisation, agriculture and the domestication of animals, and that goes on to be consolidated throughout the whole of the Neolithic period.

This seemingly "new" way of perceiving the human body is also noted by the lack of hybrid representations during this time. That being said, the modern human-animal dichotomy is not the only way to see or experience the world. Just like sedentarisation itself, the shifts in the perception of the body were extremely slow processes, that would probably differentiate between different animal species, namely domesticated.

It is, thus, possible to trace back to the Neolithic features occuring in all the following periods, thanks to the transition in human *embodiment* "*from landscape and animals to the bounded body, bounded spaces and social networks, and material things*" (Boric *et al.* 2013).

Another example is the pottery object known as Gavà Venus, from the prehistoric Gavà mines (Barcelona), Spain. Dating from the Middle Neolithic period (Bosch 2009), it was found in a negative structure, and, although it is very fragmented, it has many anthropomorphic elements. It has been interpreted as a female, pregnant "idol" (Fig. 1-B). Its hands with detailed fingers and possible rings rest on its belly; it has small incisions below the face and on the arms, that have been interpreted as some sort of adornment – and we should keep in mind it was found on a site mined for variscites used in jewellery. One of the most striking things about this representation is the eyes: two big almost solar circles.

A similar iconography (re)appears in later objects, such as "idol-plaques" and the "truncated cone clay figurines" from the second half of the 4th millennium BCE, in the south of Iberia, mainly in settlement sites in the Portuguese region of Alentejo (Fig. 1-C). The latter have brief individualisations of the face: the eyes and nose were achieved by pressing fingers onto clay, with incised lines below them. Here, the anthropomorphism is ambiguous, but they could represent clothed, or even masked, bodies (Amor Santos, 2025).

During the Neolithic, there seems to be a transition from a schematic body to a *slightly* less schematic body, where the face, eyes and nose are individualised, particularly in the final stages of the period and in the Southwest of Iberia. It is almost as if the continuity and consolidation of the sedentarisation processes and consequent population growth led to the rising importance of the face and sight, consolidated in the following millennium. And even if these features are still abstract, they show the growing relevance of the most expressive and communicative part of the body (as shown by cognitive psychology, cf. Downing and Peelen 2015), at a time when funerary practices also seem to demand observation, namely with the megalithic phenomenon.

Thus, these figurines and even some anthropomorphic "idol-plaques" (e.g. Bueno Ramírez 2021) seem to be the prelude of a representation style that would become highly disseminated during the final stages of the Neolithic and the Chalcolithic, generally corresponding to the 3rd millennium BCE. Usually known as the "ocular motif" (Fig. 1-D), it consists of two big eyes, sometimes framed with curved eyebrows, and often accompanied by facial lines or incisions, traditionally interpreted as facial paintings or tattoos, but has also been interpreted as scars (Escacena

Carrasco 2016), and more recently as masks (Sanches *et al.* 2021).

The 3rd millennium BCE is a period of affirmation of cultural regional differences, made clear through the artefactual variety particular to each region, whilst also showing comparable economic and social increment. Nevertheless, because of its vast areas suitable for thriving agricultural practices, it is in the Southwest of the Iberian Peninsula that we see the development of new ways of affirming lived spaces (whether permanently or only during specific times of the year) through their delimitation with walls or ditched enclosures. This is also the region that reveals the most numerous concentration of anthropomorphic portable artefacts[2].

The "ocular face" appears in different areas of the Iberian Peninsula, from local pottery decorations (e.g. Los Millares, cf. Martín Socas and Cámalich Massieu, 1982) and figurines, to rock art (e.g. Sanches *et al.* 2021). The fact it was vastly disseminated doesn't necessarily correlate to groups of people being unified and culturally standardised, but it does point to the southern Iberian Chalcolithic societies not only being open to external stimuli – made clear through objects in ivory, for example, but also to the internal and peninsular communication web which far exceeded the Southwest.

In the second half of the 3rd millennium BCE, the anthropomorphism of the ocular motif is clearer than ever before as it appears in a typology known as the naturalistic figurines, found in various sites of southern Portugal and Spain (e.g., Valera and Evangelista 2014, Hurtado 2009). Ranging from 10 to 20 cm high, they very clearly represent human bodies (Fig. 1-E). They were found whole and fragmented, in funerary and settlement contexts, including in what is thought to be a workshop. They are realistic yet standardised: they are standing with arms closed around their waists, sometimes holding an object that could be a baston (Fig. 1-E). Their heads have hair and faces with big eyes, eyebrows, noses, sometimes mouths, and incised lines on the cheeks. And sometimes, but not always, they have indicators of biological sex. So, even if these are the most "naturalistic" and proportional representations, this is a standardisation of a clearly tense and unnatural posture.

With the transition to the Bronze Age, the ocular motif fades, as do most of the political and social elements characteristic of the previous period. These shifts in the transition to the 2nd millennium BCE are mirrored in the treatment of the physical and represented body. In both cases, what used to be extremely clear visual markers gives way to a gradual modesty.

This is clear in the funerary contexts, with the end of the megalithic phenomenon, while small individual monuments appear in some areas, and in others the first cremation contexts emerge, pointing to new perceptions of the human body, new belief systems and new relationships between the landscape and the body (e.g. Vilaça, 2017). Some of the Bronze Age settlements allude to the body with discreet evocations on small objects, through things like feeding bottles and twin vessels (Vilaça and Amor Santos 2023; Amor Santos 2020: 131-162), new subtle ways of perceiving the body.

During this time, an effective territorial marking which uses the representation of the body regains importance – the statue-menhirs –, although building on older traditions. Those are the most expressive body representations, and they sometimes include the representation of garments and objects like weapons. Some even point to the possibility of tattoos, which could link this phenomenon to older traditions seen in portable objects and rock art of the previous millennia.

The new *body world* seemed to demand a more individualised and territorial marking, more effective and visible, exceeding the funerary megalithism, at a time when human mobility increases, renewing the 3rd millennium BCE contact networks (Valera 2017), all the while demanding the (sometimes) anthropomorphic markers of statue-menhirs and stelae to be looked at and interpreted. Despite the body almost completely disappearing from portable objects, throughout the Bronze Age, some (real, physical) bodies were individualised and differentiated through the use of metallic ornaments, namely gold.

This, of course, continues during the 1st millennium BCE. At the beginning of the Iron Age, the necklace of Herdade do Álamo (Moura, Beja, Portugal) displays in its lock a schematic anthropomorph (Fig. 2). This necklace was found in 1930 and dates from the transition to the 1st millennium BCE. It is a very important piece as it has the very first figurative motive in gold jewellery of the West of the Iberian Peninsula (Vilaça 2013a: 101), and it happens to be an anthropomorph composed of small punctured circles that create a triangular head, an hour-glass body made by two inverted triangles, and two legs. The anthropomorph appears alongside other geometrical decorations, differing greatly from the remaining necklace (aesthetically and technically), possibly indicating different moments of goldsmithery, as well as the long duration of use of the object.

More frequently than before, during the 1st millennium BCE, the body is represented in jewellery – namely in the so-called "orientalising" jewellery, where anthropomorphic representations reference mostly Phoenician divinities. This speaks to the relation of performance between real

[2] cf. Bueno Ramírez and Soler Diaz 2021a, Fig. 7, for the find-location of most known figurines and other "idols" from the 4th and 3rd Millennium BCE in the Iberian Peninsula.

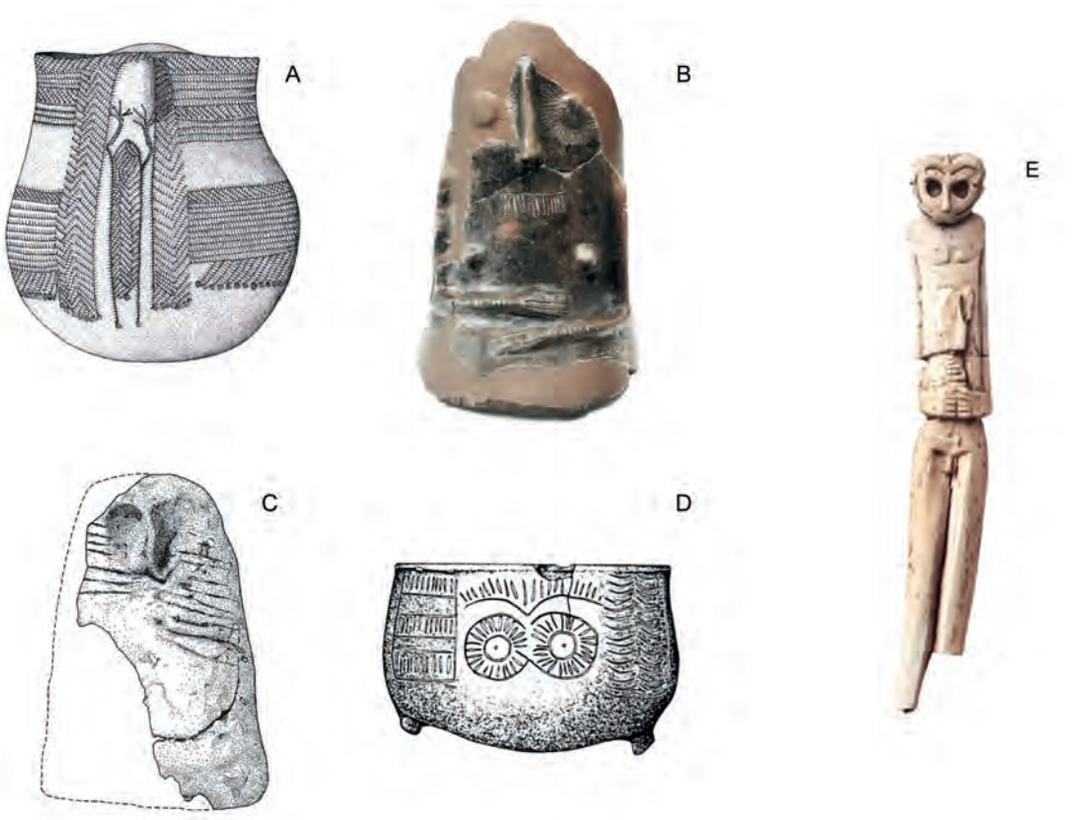

Figure 1. Portable objects with anthropomorphic representation found in the Iberian Peninsula mentioned in this text (without scale): A. Cardial pottery from Cova de l'Or, Alicante, Spain (height: c. 15,60 cm), drawing: Martí Oliver and Hernández Pérez, 1988. B. "Venus" of Gavà Mines, Barcelona, Spain (16 cm x 11 cm), photo: Josep Casanova, Museo de Gavà, in Bosch 2009. C. Example of a "truncated cone clay figurine" from the 2nd half of the 4th Millennium BCE: "Idol" of Comporta, Setúbal, Portugal (height: c. 14 cm), drawing: Soares and Silva 2013. D. Vessel with "ocular" motif from Los Millares, Almeria, Spain (7,8 cm x 11,2 cm), drawing: Martín Socas and Camalich Massieu 1982. E. Ivory "naturalistic figurine" from the complex of ditch enclosures of Perdigões, Reguengos de Monsaraz, Portugal (height: c.12 cm), photo: Valera and Evangelista 2014.

bodies and representations. At the same time, the body seems to return to pottery decorations, albeit in very schematic and ambiguous forms (Amor Santos, 2020: 46-50). With new and renewed external contacts, new technologies regarding metal work emerge, but the lost wax casting is now also used for bronze *ex-votos* figurines. During the Iron Age, the body is represented whole and intentionally fragmented, influenced by foreign trends, reflecting once again the socio-political landscape of the communities to which it belonged.

With this necessarily brief overview, small and bigger transitions emerge through the scope of long diachrony. These should be viewed as the result of gradual changes in the perception of the body, extended at different levels through time and space. The transition periods simultaneously translate and are translated by the *body worlds* (Harris and Robb 2013) of which they are part of.

5. The anthropomorphism of Iberian statue-menhir and stelae: a preliminary approach

Creating graphisms on stone materials of large dimensions and/or of reduced mobility did not originate with the pre- and protohistoric statue-menhirs and stelae phenomena. Far from it, as the multiple examples of Upper Palaeolithic rock art illustrate. In fact, archaeological areas like the Côa valley (Portugal) demonstrate how these types of artistic expressions, as well as paintings in rock shelters, have perdured throughout millennia. The means of obtaining such artistic expressions (that is, the objects and raw materials used to create them) might have changed, and so did the meanings and subjects represented.

Nevertheless, the statues-menhir and the stelae that populate the Late Prehistory of the Iberian Peninsula play an important role in understanding their *body world*, and they explain how the later proliferation of Bronze and Iron Ages stelae became one of the main expressions of body representation in the western part of the Peninsula, contrasting with the lack of anthropomorphic representations in portable objects, particularly during the Bronze Age.

The anthropomorphic statues-menhir can be traced back to the final stages of the Neolithic, for example in the Évora region (Alentejo, Portugal). They are monoliths, either with natural or smoothed/worked edges and of subcylindrical or ovoid morphology, generally with only one

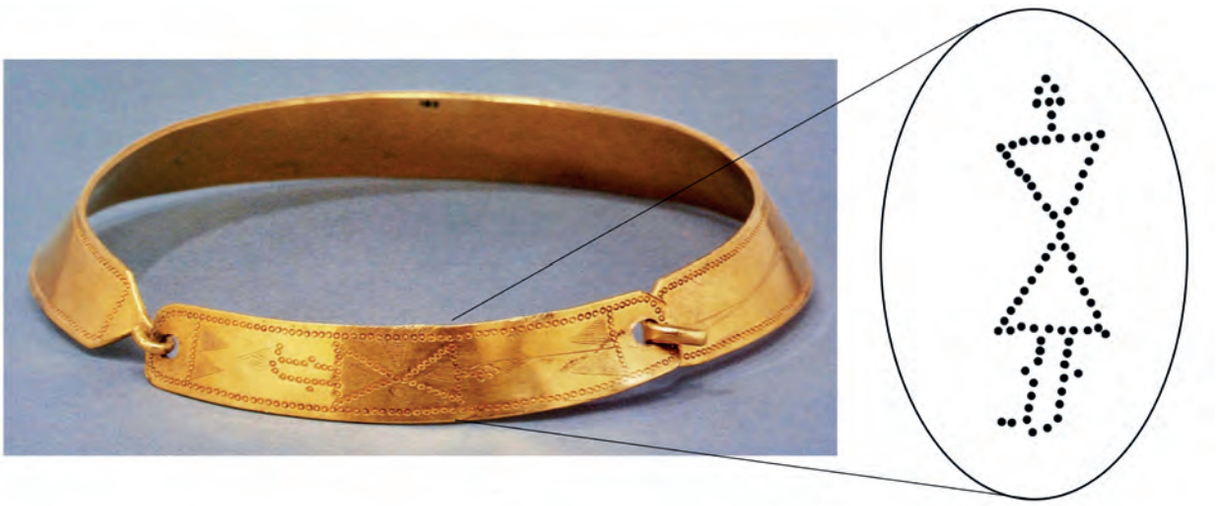

Figure 2. Gold necklace from Herdade do Álamo, Moura, Portugal (14,2 cm in diameter, 2,7 cm in width). Detail of the clasp or spacer with anthropomorph. Photo: Museu Nacional de Arqueologia (Lisboa), Drawing: Amor Santos, 2020. Adapted.

flat side prepared for the anthropomorphic representation (Gomes 2011, 13).

Sometimes, statue-menhirs actually are reutilisations of menhirs, as occurs in the Almendres Cromlech, Portela de Mogos Cromlech and Vale Maria do Meio Cromlech, all located in the Évora region (Portugal). The anthropomorphic "ocular face" which appears in some of these statues-menhir has been situated by Mário Varela Gomes (2011, 14-16) in the Middle or Late Neolithic, coinciding with a later or even final stage of the prehistoric life, or "ritual usage" (*idem*), of these monuments. It was concluded with the archaeological excavations that the flatness of the side of the monoliths was artificial and done *in situ*, because some of the remains of the stone were found near some menhirs (*idem*). The motifs were generally engraved or in light relief, with the circular eyes having a central point for the representation of eye pupils. The nose has a subrectangular shape, or less frequently, a U shape. When the mouth occurs, it is represented by a single line. Below the nose (and mouth) generally is a "lunula", i.e., a depiction of an actual object that can be found in funerary contexts in the region (cf. Gomes 2011, 33, Est.4).

These examples demonstrate, the relations between anthropomorphic representation and less movable representations: the ocular face, albeit with its own particularities, appears in the later stages of these monuments on reused menhirs, beginning the somewhat standardisation of a clear anthropomorphic motif that would, in the following millennium, become highly popular in the southwest of the Iberian Peninsula, whilst also appearing in other southern regions, and even on some pottery decorations and rock art in northern Portugal.

On the other hand, they mirror ancient ways of depicting and/or giving human attributes to monoliths, a tradition that predates the Late Neolithic statue-menhirs. Numerous older menhirs were shaped into phallic morphologies, with or without added carved motifs: the phallus could be evoked by emphasizing the already suggestive shape of the rock; carvings could also make the anatomical representation more evident. These occur, for example, in the menhir of La Pepina (Fregenal de la Sierra, Badajoz), dated from the Neolithic-Chalcolithic transition (Berrocal-Rangel 1991, 218, Fig.3), to whose phallic shape were added incised undulant lines, interpreted as hair or as a transformation of the glans into a "human head" (*ibid.*: 212; Berrocal-Rangel *et al* 2022)."

The Iberian statues-menhir and stelae from the Late Bronze and Iron Ages should, then, be seen as an advanced stage of a long process of creating artistic representations on stones of considerable dimension. Even though not all stelae can be considered anthropomorphic, it should be noted that they mirror, in turn, long processes of construction, development and persistence of bodily ideas and particular social contexts.

Even their geographic distribution predominantly in the West of the Iberian Peninsula (Celestino Pérez *et al.* 2011; Barroso Bermejo 2021, 337), despite being reflective of the particular cultural and political background of the time, when linked to a long diachrony perspective on anthropomorphic representations (Amor Santos, 2025) speaks volumes on the longevity of such processes.

Their larger proliferation south of the Guadiana river reflects, for example, the tradition for higher percentages of portable artistic expressions in the material culture (Bueno Ramírez and Soler Diaz 2021b, 36), a natural consequence of the bigger settlement sites since Late Neolithic and Chalcolithic periods. Even when these fade in importance and their material representations of human bodies seemingly disappear (as well as other aspects of their material culture and funerary practices), the unquestionable

differences in the new ways of anthropomorphising things prevalent some centuries later (particularly during the Late Bronze Age) still reveals similarities with older graphic models, as some authors before us have argued for the relationship between Late Neolithic and Chalcolithic slate plaques and stelae (e.g., Vasconcellos 1910; Almagro Gorbea, 1972), despite their contextual and provenience differences (Barroso Bermejo 2021, 338).

The greater monumentality of protohistoric stelae and statue-menhirs in the region north of the Tagus river, particularly with the anthropomorphic references being more evident in central and northern regions, expresses, in the long diachronic view, a deeper shift in anthropomorphic representation. This is because the region had, in the previous millennia, resorted to much less anthropomorphic expressions, mostly in rock art and only a couple examples in local pottery decorations (e.g. Sanches *et al.* 2021).

The act of marking raw materials in a (relatively) fixed site with more or less explicit anthropomorphic references seemed to grow in importance during the Late Bronze Age and Early Iron Age. Despite being clearly rooted in older traditions of portraying the human body (or something that is made in its image), the anthropomorphism is now, on the one hand, monumentalised (through the dimensions of the statue-menhirs and stelae) and individualised with represented objects (namely, but not only, weapons). Bearing in mind the immense existing variability inherent to these objects and their numerous typologies, there are statue-menhirs and stelae with direct references to the body, although these are also only frequently inferred.

Bronze and Iron Age stelae have been one of the most interesting topics of archaeological discussion in the Iberian Peninsula for numerous decades now (e.g., Galán Domingo 1993, Celestino Pérez 2001, Vilaça 2011, among many others). It is not our intention to develop further discussion on their classifications and distributions, nor even to recreate historiographical accounts of the state-of-the-art or discuss new developments on these magnificent stone dilemmas – the reader will find in-depth works on any of those topics in this very volume. We want to discuss the relations between such objects and the human body, and in what way they relate to the *body world* to which they belong, as we have previously hinted.

One of the most challenging aspects is the lack of context for many of the known cases, bare of their original site of implantation. This can be explained by their characteristics (prepared slabs and decorative "symbols"), attractive to other uses, as it becomes clear even in the present day, with many cases of stelae found reused in walls, for example. This contributes to the extreme difficulty in proposing a single secure function for the stelae, despite the many theories that have been put forward throughout the last decades. Nevertheless, there is a consensus when it comes to the prolonged use of stelae (Barroso Bermejo 2021, 338).

Simply put, protohistoric Iberian stelae and statue-menhirs both formally consist of three-dimensional objects with bi-dimensional representations on one or two surfaces. They are generally known as standing (decorated) stones but vary in size, morphology, rock type, surface treatment, decoration styles (although with predominantly engraving techniques) and motifs.

Taking into account the extensive literature already developed regarding statues-menhir and stelae, different levels of anthropomorphism can be recognised, not only regarding the rock materials but also the representations in themselves.

On this basis, we offer a preliminary proposal for the systematisation of the statue-menhirs and stelae's anthropomorphism, namely with five analytical groups (to be further developed and discussed in the future). Note that these preliminary analytical groups can be articulated with each other and are not exclusive; the same statue-menhir/stelae can integrate more than one of these groups of anthropomorphism simultaneously:

Anthropomorphic stone base/surface – when the stone is intentionally shaped to resemble a human body, or parts of it (e.g. head, shoulders, etc.).

An example is the stele of Boulhosa (Paredes de Coura, Viana do Castelo, Portugal), dated between the Chalcolithic and the Middle Bronze Age (Correia 2010, Vol II, 43). The morphology of this stele was shaped to clearly present a "head", "neck", and two "shoulders" (Fig. 3-A). Its decoration has two perforations at the top of the "head" that could represent the eyes, a possible representation of a necklace and of a belt, and some suggest it also portrays the representation of a weapon (Bueno, Balbín, and Barroso 2005: 608).

"Para-anthropomorphic" material base/surface – when the anthropomorphism of the prepared stone base and of its decoration is not clear, leaving room for interpretation.

Nave I (Moimenta da Beira, Viseu, Portugal) is here a good example, with its dubious anthropomorphism stone base (Fig. 3-B). The stele of Nave I shows the deliberate use of the irregularities of the stone surface, with only the sides and the anterior surface smoothed (Cruz and Santos 2011, 124-125). De decoration is schematic: a trapezoidal elongated shape with concave larger sides and pronounced corners, followed on top by a rectangle shape, previously interpreted as a neck (*idem*); six grooves outline the piece, starting from the larger sides of the trapezoidal shape and two grooves are on the posterior surface, above a horizon-

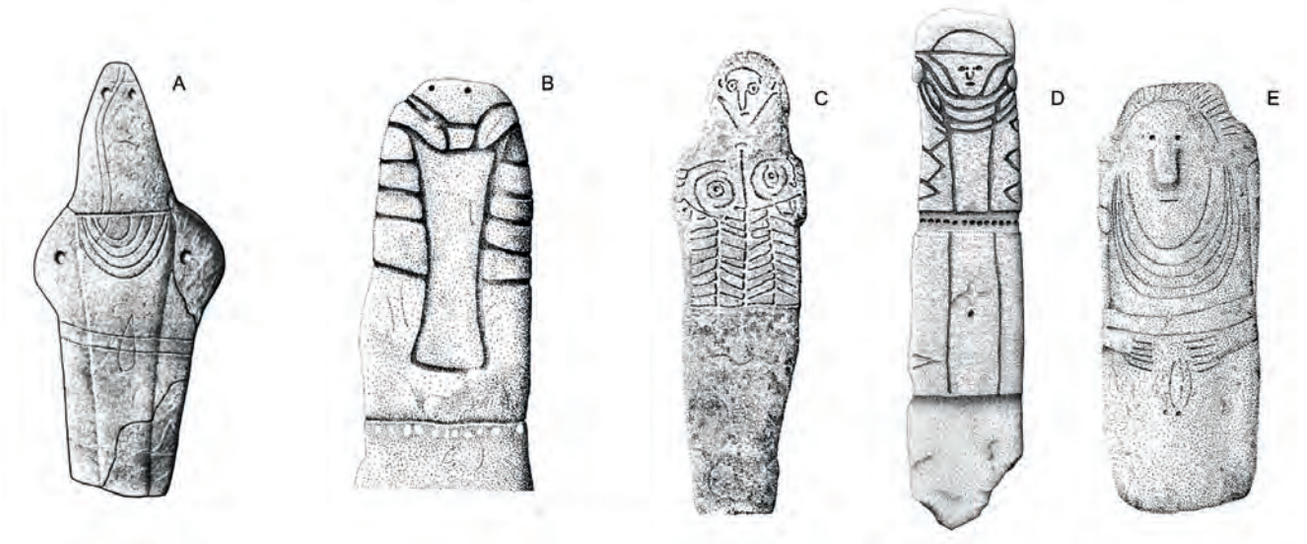

Figure 3. Drawings of statues-menhir and stelae mentioned in the text: A- Boulhosa (Paredes de Coura, Viana do Castelo, Portugal), (height: c. 112 cm), drawing: Bueno, Balbín, and Barroso 2005; B- Nave I (Moimenta da Beira, Viseu, Portugal), (height: 136 cm), drawing: André Tomás Santos in Cruz and Santos 2011; C- Ermida (Ponte da Barca, Portugal), (height: 150 cm), drawing: Baptista 1985; D- Nave II (Moimenta da Beira, Viseu, Portugal), (height: 233 cm), drawing: André Tomás Santos in Cruz and Santos 2011; E- A-de-Moura (Guarda, Portugal), (height: 102 cm), drawing: Silva, 2000.

tal groove all around the base of the stone. It has a possible head of sub-trapezoidal shape and two shallow cavities interpreted as eyes (*idem*). This stele has been first interpreted as dating from the final stages of the 3rd millennium BCE (Cruz and Santos, 2011), but recent excavations at the site might offer new insights into its chronology.

Explicit anthropomorphic representation – when the human body is partially (e.g. head, eyes, shoulders, breasts, etc.) or in (almost) its entirety present.

This occurs, for example, in the statue-menhir of Ermida (Ponte da Barca, Portugal), with a representation of a face and breasts (Baptista 1985, Jorge and Jorge 1990) (Fig. 3-C). The stele of Nave II (Moimenta da Beira, Viseu, Portugal) is also a great example because its decoration makes it undeniably anthropomorphic (Fig. 3-D): besides a very detailed face, there seems to be an indication of clothing and even adornments (e.g., possible necklaces) (Cruz and Santos, 2011).

Indirect anthropomorphic representation – when no explicit reference to the human body is present, but the distribution of the represented elements on the stelae can evocate a human body. When this happens, mostly with the representation of weapons, the location of the objects (or "symbols") represented on the surface of the stelae seems to serve the specific purpose of making the stelae themselves "bodies of stone". This "*metaphoric link between the slab and the human body*" through the disposition of the motifs on the surfaces of stelae has also been mentioned by authors such as Marta Diaz-Guardamino 2014, 336.

The Final Bronze Age stele of Aldeia Velha (Sabugal, Portugal) is an example (Fig. 4-A). With no direct anthropomorphic references, the represented elements are distributed approximately where they would be used in a real/physical human body: the slightly conical helmet appears on top of the prepared stone slab (implying this spot as the "head"), and the represented shield is located at the central part of the slab (Vilaça, Osório, and Santos 2011, 348-353), just where it would be if being used by a human body. Amongst other things, it has the representation of a sword and a spear, respectively below and above the shield. Because both sword and spear are pointing in opposite directions, it could suggest they were to be held by different hands. In any case, this only reiterates the "body of stone" of the stele of Aldeia Velha.

Reutilisation of anthropomorphic material bases – occurring frequently with statues-menhir, as we already pointed out with the examples from the Évora region, but also with stelae. The possibility of "long-use cycles" for menhir, where these persisted and were used until later times has already been pointed out (e.g. Bueno-Ramírez, Balbín-Behrmann, and Barroso-Bermejo 2016: 49).

In fact, a good example of their long duration is the Final Bronze Age stele of Telhado (Fundão, Portugal), where an older menhir was reused and was engraved with a conic helmet, spear with oval blade, sword, mirror and shield (Vilaça 2021: 339) (Fig. 4-B). It is also interesting to note the overlap of different anthropomorphisms that goes into play in the reutilisation of already anthropomorphic slabs/monoliths. For instance, the menhir 78 of São Martinho (Castelo Branco)

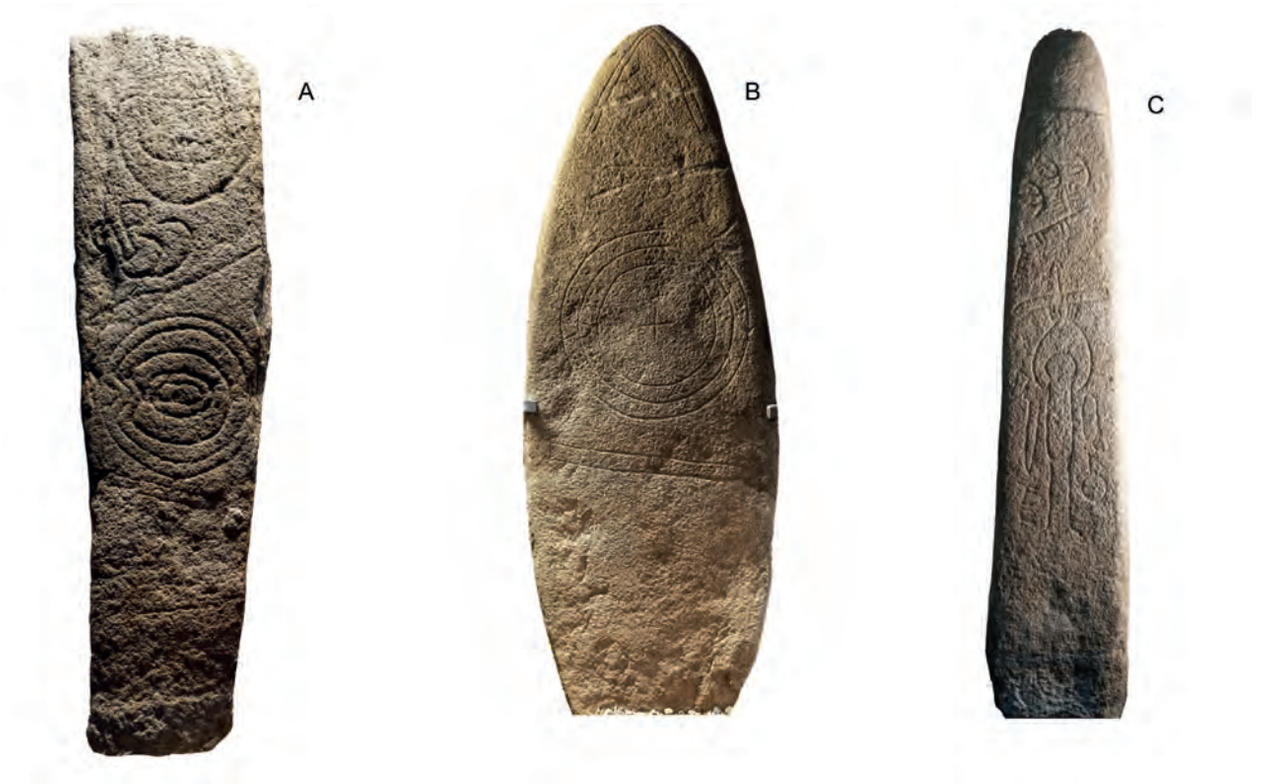

Figure 4. Other stelae mentioned in the text: A- Aldeia Velha (Sabugal, Portugal), (height: 188 cm); B- Telhado (Fundão, Portugal), (height: 267 cm); C- "Menhir 78" of São Martinho (Castelo Branco), (height: 207 cm). Photos: A. Felicísimo, KRAKEN Group.

(Fig. 4-C), made phallic in the 5th-4th millennium BCE, was reused in the Final Bronze Age with an anthropomorphic representation (Vilaça, Santos and Marques 2004, 164-166, with prior bibliography). Representations of human bodies over past references of parts of human bodies: another indicator of the connection between memories, actions and places of ancestors, raising possibilities between revendication and/or reinvention of the past.

In the case of the stelae from the western Iberian Peninsula, decorations resort mostly to engraved motifs, mainly related to weapons (namely the sword, shield and spear, sometimes helmet) and to objects associated with body care (such as mirrors, combs, fibulae), and with much less frequency, cars or musical instruments, as well as non-identified objects (Vilaça 2012, 151).

Some authors have argued that armed stelae (to which we could add armed figurines and armed anthropomorphs in rock art) are the exception when it comes to the few connections generally made in archaeological interpretation between inequality and artistic expressions in the Neolithic, Chalcolithic and Bronze Age (Bueno-Ramírez, Balbín-Behrmann, and Barroso-Bermejo 2016, 42). However, it should be noted that traces of inequality can be attested earlier, for instance with megalithic monuments, particularly funerary, highlighting different treatments in death.

Besides the raw material in which they are made of and their dimensions, the most important aspect in which stelae and statues-menhir differ from the small-scale portable objects with anthropomorphic references previously discussed is the emphasis on the object's surface rather than its "*interior substance or corporeality*", reducing the three-dimensionality (of figurines and living bodies) to a "*two-dimensional static surface for display (…) of key social icons*" (Harris *et al.* 2013, 74; Robb 2009).

When analysing the anthropomorphism of these objects, the scarcity, or even absence, of sexual markers represented in stelae and statue-menhir is striking. This, however, has not stopped traditional interpretations of these objects through a sexual/gender dichotomy (e.g. Galán Domingo 1993, Celestino Pérez 2001). In this view, weapons tend to be interpreted as evocative of male warriors and elements of adornment or dress are attributed to females (cf. Berrocal-Rangel, 2012). Some researchers, like Marta Diaz-Guardamino (2014, 337), have already pointed out that "*few examples provide a clear-cut correspondence between weapons and males (…) and adornment and females*". Furthermore, the coexistence between weapons and personal objects such as mirrors or fibulae is fairly common in western stelae.

A similar interpretative phenomenon occurs with traditional interpretations for body representations in portable objects, regardless of their chronologies (Amor Santos, 2025; Amor Santos 2020, 166-170): the assumption, by traditional archaeological interpretation, of sex (and, by extension, gender) in representations and art, even when

no clear indicators are present. For older chronologies, traditional interpretations tend to link body representations to female deities, as Ana Vale (2015) pointed out for late prehistoric research in Portugal.

The lack of sexual indicators is often assumed as a methodological problem, but this premise takes out of the equation *who did* the representation (in the past) and focuses on *who interprets* (in the present), even if unconsciously. We should consider, instead, what was *selected* and represented, since it is very difficult to access its true symbolic meaning. The problem with the ambiguity of representation, be it around sexual indicators or even their anthropomorphism, has to do with *interpretation*, much more than with methodology.

When it comes to stelae and statue-menhirs, the data generally points to the representation of sex (and by extension gender) not being a central part of the process of creating the representations – this has also been pointed out by other authors (e.g. Diaz-Guardamino 2014, 338). This does not necessarily mean the bodies depicted were asexual, nor does it mean the opposite. The stelae or statue-menhirs would have been understood regardless of the absence of sexual indicators because those were not considered relevant.

Even when sexual markers seem to occur, interpreting is often not a simple task, and different researchers can argue for different attributes. For example, a male phallus was attributed to the stele of A-de-Moura (Guarda) by Marcos Osório (Silva, 2000) and considered female by Maria João Santos (2009, 2010) and João Luís Cardoso (2011, 99) (Fig. 3-E).

Some stelae and statue-menhirs have representations of breasts – although these may not always be considered sexual indicators, as they are not exclusive to females (Amor Santos 2020, 166). Some cases, however, point to probable female breasts: two concentric circles engraved (that seem to create relief) occur in the statue-menhir of Ermida (Ponte da Barca, Portugal) whose chronology is situated between the final stages of the 3rd millennium BCE and the Bronze Age (Baptista 1985: 38, Jorge and Jorge 1990).

There is also an interesting phenomenon illustrated by some statue-menhirs and stelae: the addition or alteration of breasts or sexual markers to the original objects. This also occurs in older revisited monuments, for instance in the Évora region, where concentric circles were added to previously decorated menhirs integrated in cromlechs (Gomes 2011, 20).

6. Concluding remarks

Interpreting pre- and protohistoric aesthetics and art is an enormous challenge that one cannot do on one's own. It should be a holistic endeavour, relating contexts, portable objects, rock art and other art forms. As John Robb (2009, 178) puts it, we need to "*turn the interaction around and try to understand what we can deduce about the habituated reflexes of the viewer from the clues presented to guide them*". This is why we try to focus not on interpreting possible meanings of representations, but on the way they change over large periods of time.

Our adaptation of the *body world* methodology makes it possible to understand that a long diachronic scope of analysis, centred around the represented body (and on what of it was left out), reflects how objects mirror the shifts in the perception of the body, particularly in transition and cultural transformation periods.

Integrating the Late Bronze Age and Iron Age statue-menhirs and stelae with anthropomorphic references in a larger chronological scope of analysis refutes the idea that some authors tend to put forward that these objects result in the "*emergence of a widely-shared standard body*" (Harris et al. 2013, 74). This is not to say these do not portray standardised ways of depicting the human body (because they clearly do). Our point is that a "widely-shared standard body" representation had already emerged, in portable art, during the 4th millennium BCE and developed into highly naturalistic (and standardised!) forms, for example with the "naturalistic figurines".

However, during the Bronze Age, statue-menhirs and stelae demonstrate the importance given by people to anthropomorphic representation in expressive surfaces (even if drawing from much older traditions), since the body rarely occurs in portable objects. The statue-menhirs and stelae become, during this time, the most popular means of representing the human body.

If we consider that "*new technologies and ways of material manipulation lead to new comprehensions of the human body*" (Harris and Robb 2013), then the technologies representative of Iberian Pre and Protohistory show the multiple ways body representation has changed through and with time.

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CHAPTER 16

Iberian stelae and the principles of pictorial representation

Christoph Huth

Abstract

According to a fundamental assumption of archaeological reasoning resembling objects are in some way related to each other. While this is certainly the case with artefacts, it is definitely not true for pictorial representations. The way things are depicted on a plane surface is heavily influenced by cognitive processes which are not so much culturally determined but universal. Thus, "fold out" pictures of four-wheeled wagons on Iberian stela, in Scandinavian or Alpine rock art or on pottery across Europe may have nothing in common with the exception of their pictorial appearance. However, a deeper comprehension of the principles of pictorial representation may help to understand what the images were made for and what they were meant to represent.

Keywords: Iberian stelae, pictorial representation, cognition, figuration, agency

Resumen

Según un supuesto fundamental del razonamiento arqueológico, los objetos semejantes están relacionados entre sí de algún modo. Esto es cierto en el caso de los objetos, pero no en el de las representaciones pictóricas. La forma en que se representan las cosas en una superficie plana está muy influida por procesos cognitivos que no están tan determinados culturalmente como universales. Así, las imágenes «desplegables» de carros de cuatro ruedas en las estelas del suroeste de Iberia, en el arte rupestre escandinavo o alpino o en la cerámica de toda Europa pueden no tener nada en común, salvo su apariencia pictórica. Sin embargo, una comprensión más profunda de los principios de la representación pictórica puede ayudar a entender para qué se hicieron las imágenes y qué pretendían representar.

Palabras clave: Iberia, Estelas, representación pictórica, cognición, figuración, agencia.

Looking for patterns is a fundamental method in archaeology, and even more so in prehistoric archaeology, as there are no complementary sources of information apart from material relics such as objects and pictures. Analyzing differences and similarities of artefacts in space and time is a key concept of archaeological reasoning, where similarity is taken as evidence for historic relatedness of any kind. Oscar Montelius' "method", as he simply called typology, is based on this heuristic principle, and it is a standard method in archaeology to the very present.

Similarities can be very intriguing, indeed. It therefore comes as no surprise that archaeologists working on Iberian stelae and looking for comparisons for the pictorial representations on their surface readily come across petroglyphs in northern Europe. Actually, they are broadly contemporary, and they are made of the same material, i.e. stone, undoubtedly using similar techniques. Particularly depictions of wagons and chariots on Iberian stelae and in Scandinavian rock art seem to be related to each other. A recent publication sees strong formal similarities and strik-

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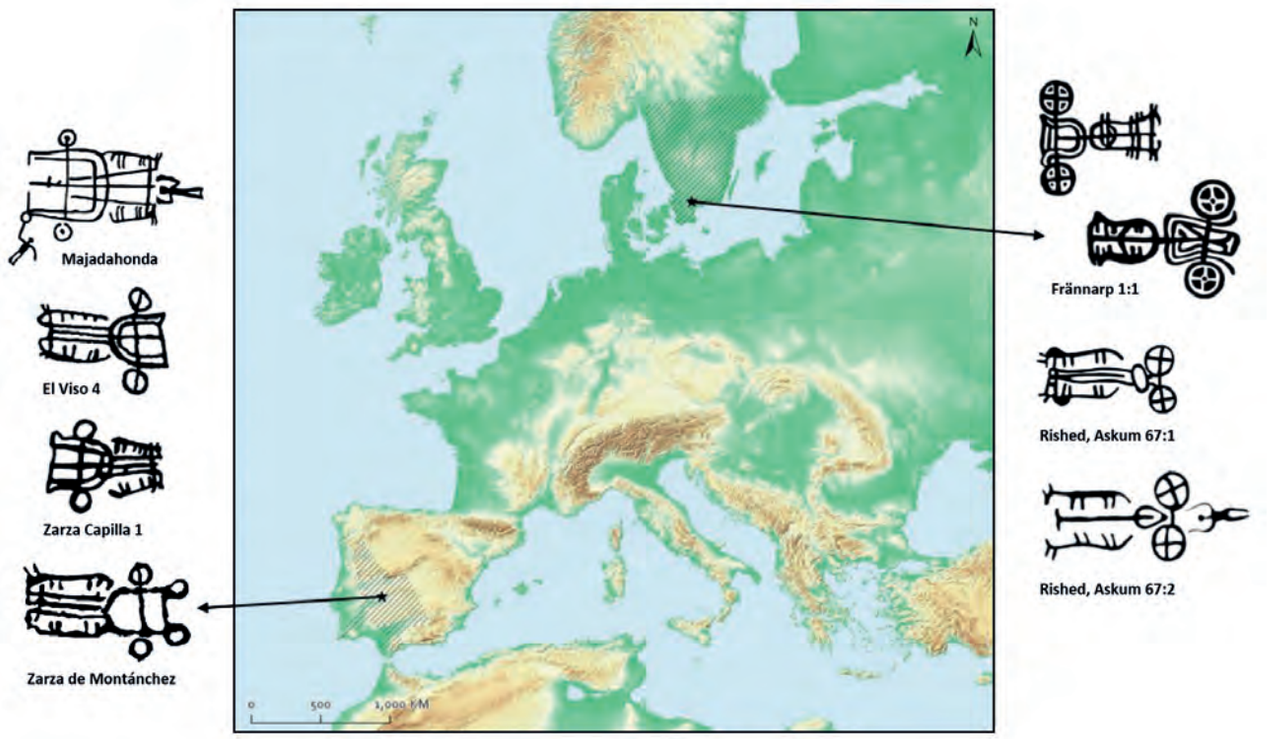

Figure 1. Distribution of chariot pictures in Scandinavian rock art and Iberian warrior stelae. After Díaz-Guardamino et al. 2022, 341 fig. 8.

ing parallelisms in the conventions used to represent chariots on Iberian stelae and rock surfaces in southern Scandinavia. Together with a common choice of motives (warriors, weapons, wagons) these are considered "to provide a relevant line of evidence for understanding the broader background and the connections of southwest Iberia with the Atlantic" (Díaz-Guardamino *et al.* 2022, 340-341 with fig. 8).

At a first glance, this conclusion seems to be fully convincing (fig. 1). But if we take a look at other depictions of wagons and chariots we will find closely resembling images throughout prehistory, from Neolithic Poland to Bronze Age Slovakia and Russia, from Scandinavia to Central Asia and last not least from Spain (fig. 2). Fig. 2,9 with a teepee, a person (possibly the charioteer) and a covered wagon is from a ledger-book of a 19th century Lakota, i.e. a native American (Mallery 1972). Although all these depictions show striking similarities there is definitely no probability that they are historically related. So how can we be sure that this should be the case with the corresponding features of Iberian and Scandinavian depictions of the Late Bronze Age?

"Fold-out" pictures, i.e. depictions showing objects from various angles at one time (like all four wheels of a wagon) can be found throughout prehistory, from the Neolithic to the metal ages, and well beyond as demonstrated by countless examples all over the world. However, there are also depictions of chariots and wagons which are entirely different, again from various periods and regions, like Mycenean Greece, Persia, Egypt, and geometric Greece (fig. 3). Although they have nothing to do with each other in historic terms, they share a common principle of pictorial representation, orthogonal projection to be precise, which makes their appearance so similar. Fig. 3,5 is a petroglyph from China showing both ways of representation, a true hybrid of fold-out picture and orthogonal projection.

A common way of explaining these differences in pictorial representation is to say that some people draw what they know about an object – what has been called intellectual realism by Piaget and Inhelder (1948) (cf. fig. 2) –, while others draw what they actually see (cf. fig. 3). Thus, sometimes all four wheels of a wagon are depicted, simply by showing the wagon from all sides at a time (which is, of course, not possible in reality). Those people using an orthogonal projective system show what can be seen in a more or less visualistic way of reproduction. Somebody favoring fold-out pictures would possibly object that in these orthogonal pictures one or more wheels are missing.

The distinction in object-centered (what is known) and viewer-centered (what is seen) pictures or rather descriptions may be useful at first sight, but it does not explain why this is so (Marr 1982). As a matter of fact, there seems to be more to it as fold-out pictures are typical for illiterate societies, while orthogonal projections are characteristic for literate societies. But this again is no explanation. For the moment being it is just coincidence.

In order to elucidate all these phenomena, it might be useful to have an analytical look at the representations

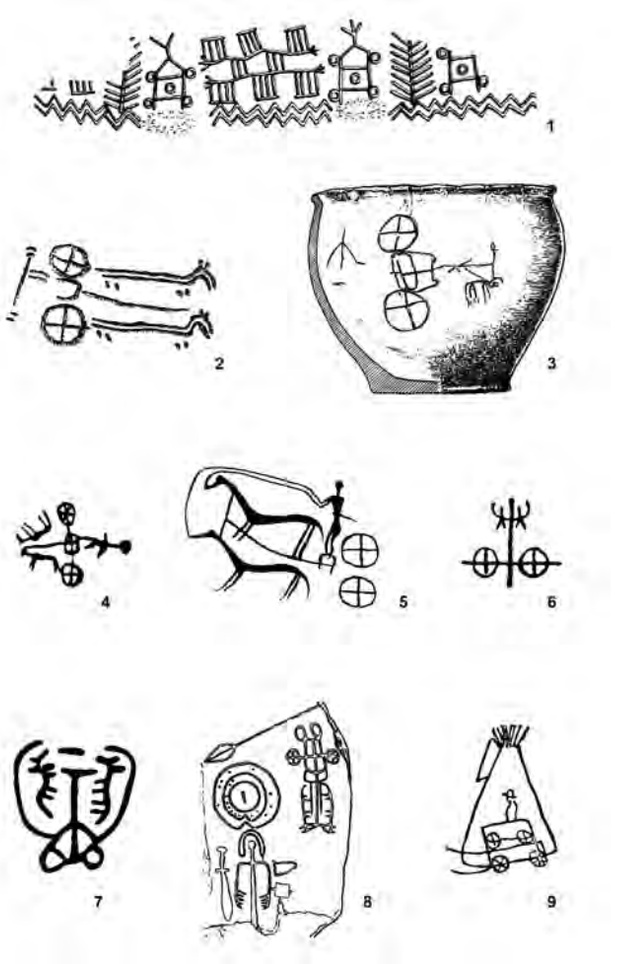

Figure 2. "Fold-out" pictures of chariots. After Huth 2003, pl. 1.

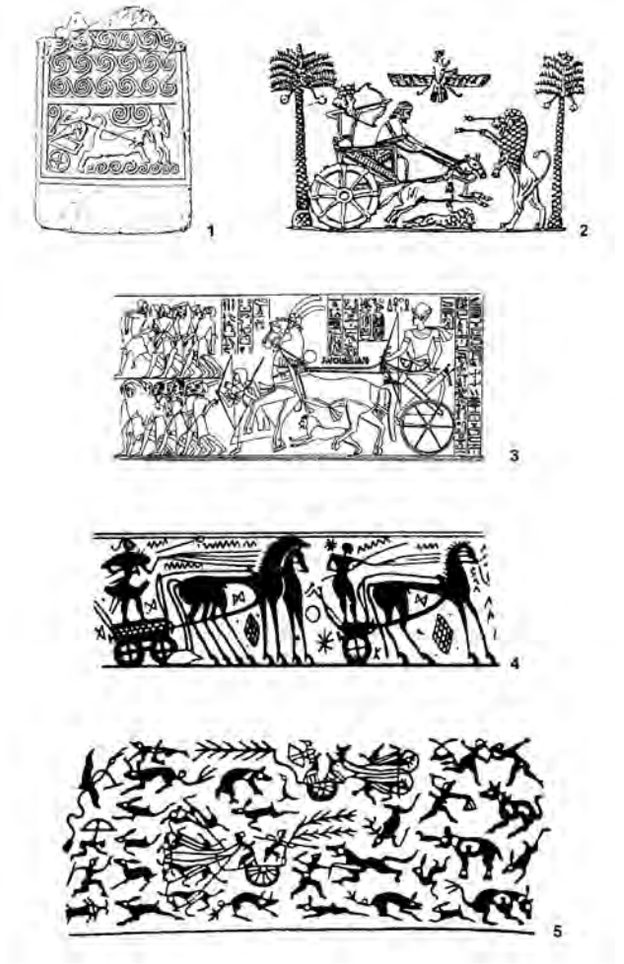

Figure 3. Pictures of chariots using orthogonal projection. After Huth 2003, pl. 2.

found on Iberian stelae first. The stela from Cabeza de Buey (fig. 4) may serve as an example for what we see, what we do not see, and what we do see in spite of reality.

What we see: a person, some sort of headgear, a spear, a shield, a sword, a fibula, a square object (possibly a mirror), a chariot drawn by a pair of horses (but no charioteer), everything drawn in an extremely simplistic manner.

What we do not see: color, light and darkness, depth, motion, correct size and proportions, spatial relations, orientation, background.

What we do see in spite of reality: a chariot from different angles at the same time (no overlaps).

These features are common to all two-dimensional pictorial representations in prehistoric societies. In order to explain the characteristics of these pictures we have to turn to visual cognition. Although there is an extensive literature on visual cognition in the arts, hardly anything has been written on the cognitive aspects of prehistoric art. In a very useful general introduction into cognition and the visual arts, Robert Solso (1996) refers among many other aspects to the problem of 3D-2D-3D-2D transformation. By this he means the cognitive processes at work in a sequence from seeing a three-dimensional object, to its reflection on the two-dimensional surface of the retina, to its recognition in the mind of the beholder as being three-dimensional, and finally to its depiction on a plane two-dimensional surface. Without going into the details of a highly complex affair, it is overtly clear that the reception and production of pictures is a matter of cognition in the first place.

The cognitive processes at work have been analyzed by John Willats in his seminal book on Art and Representation – New Principles in the Analysis of Pictures (Willats 1997). There he tries to explain in a very innovative manner why two pictures like the prehistoric petroglyph from Valcamonica and the "Rites of Spring" by Pablo Picasso may look so similar, although they have nothing in common otherwise (fig. 5).

According to Willats picture production is based on two principles. A drawing system serves to map spatial relations of the scene (perceived in 3D) into corresponding relations in the picture (depicted in 2D). A denotation system says what physical marks on a surface such as ink, traces like grooves and scratches, stand for in reality, what they denote. Together they make up what we perceive as a picture.

There are several drawing systems at hand. Projection is the most sophisticated system. In prehistory orthogonal

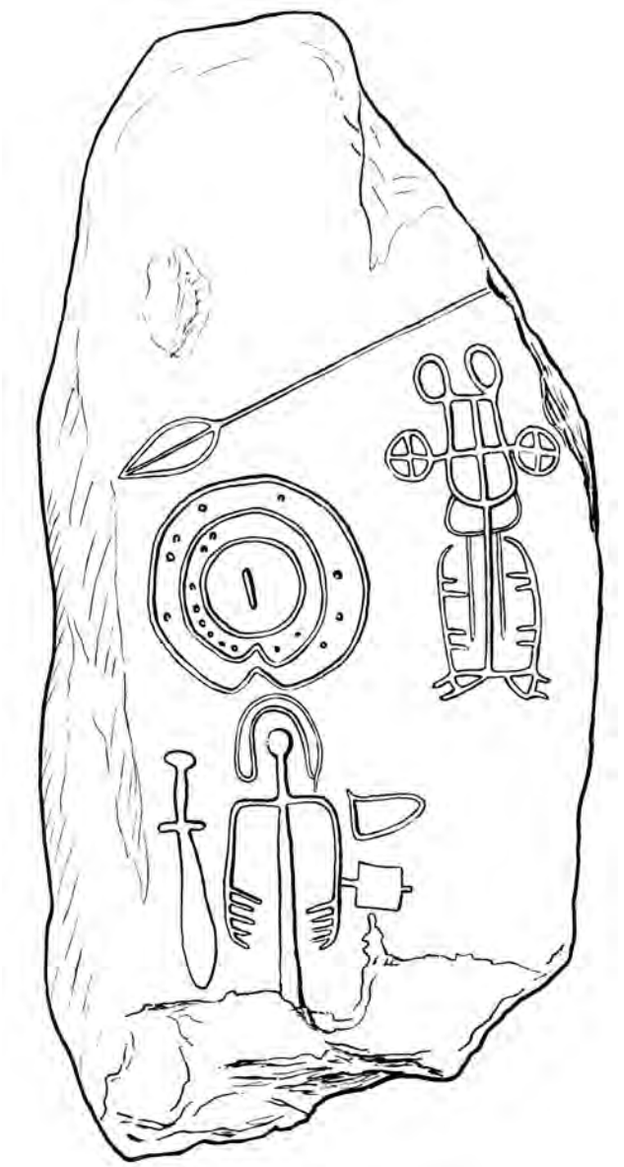

Figure 4. Stela from Cabeza de Buey, Badajoz (height: 112 cm). After Almagro 1966, 70 fig. 21.

Figure 5. (1) Petroglyph from Valcamonica, prov. Brescia; (2) Pablo Picasso, "Rites of Spring", 1959. After Willats 1997, 82-83 fig. 3,7-8.

projection is the only form to be found, and it is restricted to literate or semi-literate societies as already pointed out (e.g. situla art in northern Italy and Slovenia; geometric art in Greece and Cyprus). Oblique projection and any form of perspective are definitely unknown in Holocene prehistory. Simple drawing systems are much more common, either as topological transformations or in the form of extendedness. A topological transformation reproduces elementary types of spatial properties like touching, separation, spatial order, and enclosure. There is no overlap, there are no true sizes and no shapes. A modern form of topological transformation would be a subway map reproducing connections between the stations and their order along the tracks, but not their true location in space, their exact distance from each other and no overlap of the single lines, in order to enhance their readability. Omitting no basic and necessary information for the traveller, the picture reproduces space in an extremely simplistic way. The spread-out spatial arrangement of the single elements on the Cabeza de Buey stela (fig. 4) is depicted by means of topological transformation. Extendedness reproduces principle spatial features such as round, flat or long, like the weapons shown in the Valcamonica petroglyph or the musical instruments in Picasso's "Rites of Spring" (fig. 5). This is also the case with the single elements of the body, such as round forms for the head and long forms for the extremities.

Drawing systems are individually acquired during childhood (Freeman and Cox 1985). The various steps in drawing a three-dimensional object, e.g. a cube, follow a certain order by age, but of course they may be influenced by learning and imitation of templates. The maximum level that can be reached without instruction is oblique projection. Perspective is beyond reach without instruction. This does not mean that a person using a simpler and less soph-

isticated drawing system is to any extent retarded and behaving like a child (as has been suggested for a long time). It only means that the use of drawing systems is a function of complex cognitive procedures, and that the individual capabilities are acquired during lifetime and by no means innate (cf. Huth 2003, 34-38).

Denotation systems (according to Willats 1997) consist of silhouettes, line drawings, and optical systems (such as pointillism for example). Denotation systems map the features of a scene (scene primitives, i.e. what is visually perceived) into corresponding picture primitives such as regions, lines or points. A denotation system says what the picture primitives refer to, what they denote.

Picture primitives consist of physical marks like color, grooves, scratches etc. They are zero-dimensional (e.g. line-junctions, points), one-dimensional (lines, outlines), or two-dimensional (regions).

Scene primitives are the elements recognized by visual cognition, that is corners, edges, occluding contours, silhouettes, surfaces, shapes, volumes etc. They are not necessarily tangible (e.g. points of occlusion).

Fig. 6 illustrates the use of denotation systems and associated marks (picture primitives) in depictions of sticks and discs. It should be noted that while the result is quite different according to which systems is being applied, all depictions are valid forms of picture production. There is nothing "wrong" or "right" in them, although the recognizability of the sticks and discs strongly depends on the denotation system, and some systems are more advanced than others. Fig. 6.1 shows a stick and a disc using points as picture primitives in order to denote small bundles of light rays as scene primitives. The density of the points denotes light and shadow and by this provides information on the shape of the object. This system is not known in prehistory. Fib. 6.2 is an example of a line drawing. Line drawing is unknown in prehistoric temperate Europe except for situla art in the early Iron Age. Lines denote occluding contours and interior edges and thereby carry information on the shape of the viewed surface. The correct use of line-junctions is essential for a proper understanding of the picture primitives. L- and Y-junctions of lines stand for corners, while T-junctions denote points of occlusion. Fig. 6.3-5 illustrate the most common denotation systems in prehistory. In fig. 6.3 lines denote occluding contours only. The recognizability of the depiction strongly depends on how careful the occluding lines are drawn. As there are no interior lines the picture is potentially ambiguous, particularly so in a bottom-up process of visual cognition. Seen top-down stick and disc are still easily to identify. Generally, top-down and bottom-up processes of visual cognition work simultaneously (Zimmer 1999). However, if only one way of cognition is available, ambiguities, misunderstandings and false interpretations are highly probable. Fig. 6.4 is only a very simple silhouette in the frontal plane without any specifiying occluding contours. Willats calls these silhouettes "regions", whereby the shape of the region provides some information regarding the general shape and extendedness of the object in the frontal plane. Depictions of that type are very typical for prehistoric pictorial representation no matter where and when. Fig. 6.5 is the simplest form of a denotation system, with silhouettes ("regions" as picture primitives) simply representing volumes and their general spatial extendedness as scene primitives. The form of the volume may carry information about the specific three-dimensional qualities of an object, such as a line would stand for an oblong object. However, a round silhouette could equally denote a flat object (disc) or a spherical object (ball). In Picasso's Rites of Spring (fig. 5) it is impossible to

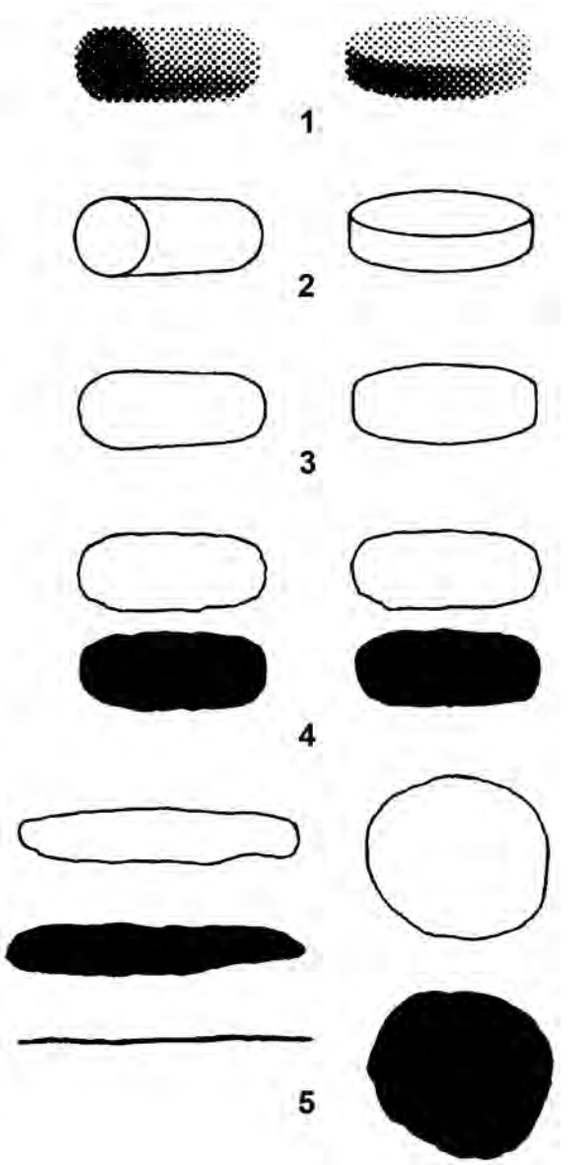

Figure 6. Denotation systems and associated marks used in depictions of sticks and discs. After Willats 1997, 102 fig. 3,4.

tell whether the dancer to the right carries spherical rattles or flat tambourines.

Like drawing systems denotation systems are individually acquired during childhood and adolescence, not least so by imitation and instruction. Not surprisingly, simple denotation systems like regions standing for volumes (in general or in the frontal plane) precede more complex forms like line-drawings and optical systems. Line-drawings are highly artificial and unlike simpler forms not universally understood. Therefore, internal lines denoting interior edges such as the folds of a cloth may be mistaken as cracks in the surface (Willats 1997, 125). This again demonstrates the importance of top-down visual cognition in order to correctly correlate picture and scene primitives.

Simple denotation systems have typical shortcomings leading to characteristic features in picture production. Where silhouettes are used as picture primitives it is simply impossible to reproduce overlapping elements. One solution would be to tear the features of a picture apart and place them separately on the surface of the picture. The stela from Cabeza de Buey is a good example for this technique (fig. 4). The warrior's body is depicted as simple regions (long for the body, extremities and fingers, round for the head) in a topological transformation showing all connected parts form the body of the warrior. In contrast, the warrior's paraphernalia are shown as regions in the frontal plane with rather exact and detailed contours. The connectedness of topological transformations is replaced by a simple extendedness and a vague proximity of the objects and the warrior. The wagon consists of regions standing for its various elements (wheels, chassis, pole, horses, although no charioteer) which are depicted in a topological transformation.

Fold-out pictures, which are so typical for prehistory, are a special way to overcome some of the inherent difficulties of picture production. They can be made by using very simple drawing and denotation systems, but they do also occur among orthogonal projections like in Egypt or in geometric Greece and Cyprus. Fold-out pictures are based on an object-centered description. They do not show what can be seen by a single-point viewer, but what is known about the object or living being. Therefore, they do not reproduce some sort of perspective (in the sense of seeing through a single focal lense), but aspects, i.e. elementary features of the thing or person illustrated. Thus, a wagon is depicted with all four of its wheels seen from different angles, the chassis and the pole from above, and the horses again from various sides. Sometimes, like in Kivik in Scania, the charioteer seems to stand in a right angle on the edge of the chassis, with the reins leading around the horses in order to avoid overlaps that are so difficult to depict (fig. 2,5). In some cases, the charioteer seems to follow the wagon on foot (fig. 2,2-4), while very frequently he (or possibly she in the case of marriage carts in the Iron Age) is simply omitted (fig. 2,6-8).

Heinrich Schaefer (1963) pointed out the principles of this kind of pictorial production in his seminal book on Egyptian art. One of Schaefer's disciples elaborated his findings in a nowadays slightly problematic work connecting the specific traits of Egyptian art and mind, and called this way of picture production "*Aspektive*" in contrast to "*Perspektive*" (Brunner-Traut 1990). Aspective art depicts things and beings alike as an additive composition of single elements. Color, light and darkness, depth, motion, correct size and proportions and spatial relations are of no importance. Size means importance in the first place. The king is always the tallest person around (cf. fig. 3,2-3). Size does not change whether something is close to or far away from the viewer. In Egyptian art spatial layering is a means of illustrating quantitity (such as groups of people or animals). There is generally no background, and in prehistoric art standing lines are non-existing. Most depictions are monochromatic.

Aspective art is by no means restricted to antiquity. It is very characteristic of medieval painting, particularly in book illustrations, but it can be found later-on and anew in modern art as a conscious return to older traditions and techniques of pictorial representation (cf. Picasso's Rites of Spring in fig. 5). Aspective is also common to children's paintings. This does not mean that aspective art is naïve or childish. It is an expression of the cognitive processes at work when pictures are being made. As these processes are very complex and picture making is a complicated and demanding task, it comes as no surprise that people tend to find similar solutions to similar problems – and this, it must be stressed, independently of historic or whatever relations. Fig. 7 shows three identical solutions in placing persons or trees standing in a circle on the two-dimensional surface of the picture. The Egyptian pond, the child's ring a ring o' roses and the Syrian miniature of the Last Supper are entirely independent in historical terms, and yet they are remarkably similar.

It is therefore neither evident nor probable that the depictions of warriors and wagons on Iberian stelae and Scandinavian petroglyphs are directly related. It is just the same solution for the same problems in reproducing a three-dimensional person or object on a two-dimensional surface. Yet it remains to be explained why people opted for simple denotation and drawing systems, especially so when they had the opportunity to encounter and adopt more complex systems like line drawing and orthogonal projection. This must have been the case at least for all those early Iron Age communities in contact with Greeks, Etruscans and Phoenicians. Sooner or later this leads to the question

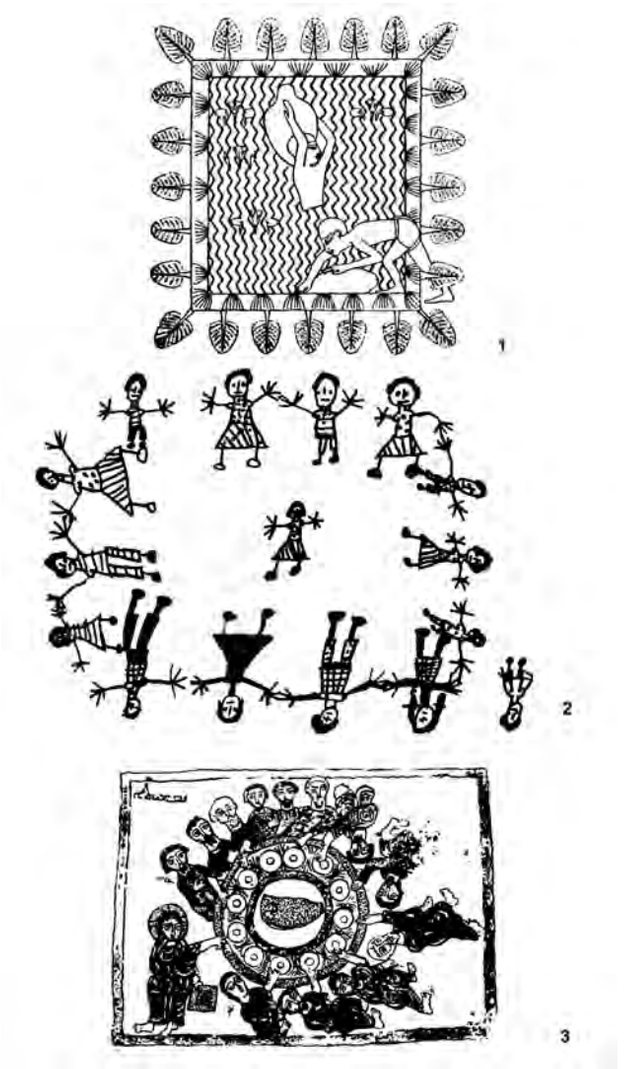

Figure 7. Three identical solutions in depicting persons resp. trees standing in a circle. (1) Egypt (after Brunner-Traut 1996, 20 fig. 9a); (2) Drawing by a girl of eight years (after Brunner-Traut 1996, 45 fig. 36); (3) Miniature from Syrian Codex, 12th c. AD (after Solso 1996, 214 fig. 8.19).

whether people did not know how to do it or did not want to do so. The first position (they did not know) assumes that a more complex technique of pictorial representation is somehow better and more desirable than a simple way of making pictures. There may be also some ethnocentric overtone to it, favoring visualistic illusionism, which is decisively typical for Western society, over all other forms of representation. Actually, there are two objections to be considered. Firstly, there are more complex forms of picture making which are not visualistic, such as Latène art or Scythian art, which are however to a greater extent focused on three-dimensional representations than the mainly two-dimensional pictures of the Bronze Age. Secondly, there are cases showing that people tried to copy pictures which were more advanced than their own. The Arnoaldi situla is a good case in point, with a scene of a chariot race imitating an Etruscan model (Huth 2003, 215-216, pl. 72). As it happens, it did not work out that well because the artist did not properly understand the principles of line-drawing used by the Etruscans. The second position (they would have known, but they did not want) is definitely less ethnocentric and seemingly noble, but not very convincing either (Zipf 2006). It is not at all clear how it should be possible to determine in the present what people did not want in the past. Even then, it remains to be explained *why* people did not want to do something.

It might be more rewarding to proceed the other way round, i.e. to try to find out what people intended to achieve. There are indeed some aspects of prehistoric picture production which may be conclusive in this respect. It is quite obvious that a visualistic depiction of things and beings was not intended in the first place. The most important matter was to make something present in a certain context, and this was done by rendering it perceptible (Huth 2016). Evidently, it was more important to show what somebody or something does, and not what it looks like. Consequently, very reduced and quite naïve depictions of horse riders such as petroglyphs in Valcamonica with people seemingly standing on horseback, or riders depicted simply by a leg hanging from a horse on bronze vessels in Kleinklein in Styria, were regarded as being entirely sufficient in the eye of the beholder (fig. 8). This is even more surprising considering that the bronze vessels of Kleinklein were part of the most sumptuous burial of the eastern Hallsttatt group (Egg and Kramer 2013), and that with a certain probability those commissioning these works were aware of more ambitious pictorial representations from neighboring Etruscan and Villanovan communities.

It would be misleading to take prehistoric pictorial representations as a visualistic description of whatever kind, least so of the everyday world around. It is no coincidence there are no landscapes, rivers, mountains, roads, houses, domestic animals, people such as farmers, merchants, artisans, or slaves among the imagery of prehistoric societies. Pictures make things visible, they invoke and render forces at work, like deities, ancestors and spirits, species masters, animals (mostly wild), and warriors in the case of the Iberian stelae. The picture is an icon of the forces at work, forces which Alan Strathern (2019, 4) and Marshall Sahlins (2019, 911) call metapersons or metahumans. In this sense, the picture is an actor in itself, maybe not "like a pure, self-immanent presence, something like an ectoplasma", (Descola 2021, 25), but certainly like something possessing agency towards people interacting with it (Huth 2016).

The agency of pictures has been demonstrated by Alfred Gell in his groundbreaking work (Gell 1998), however in a somewhat reduced form of a more technical way of human activity. Günter Dux analyzed the main features of this kind of reasoning from a historical-sociological

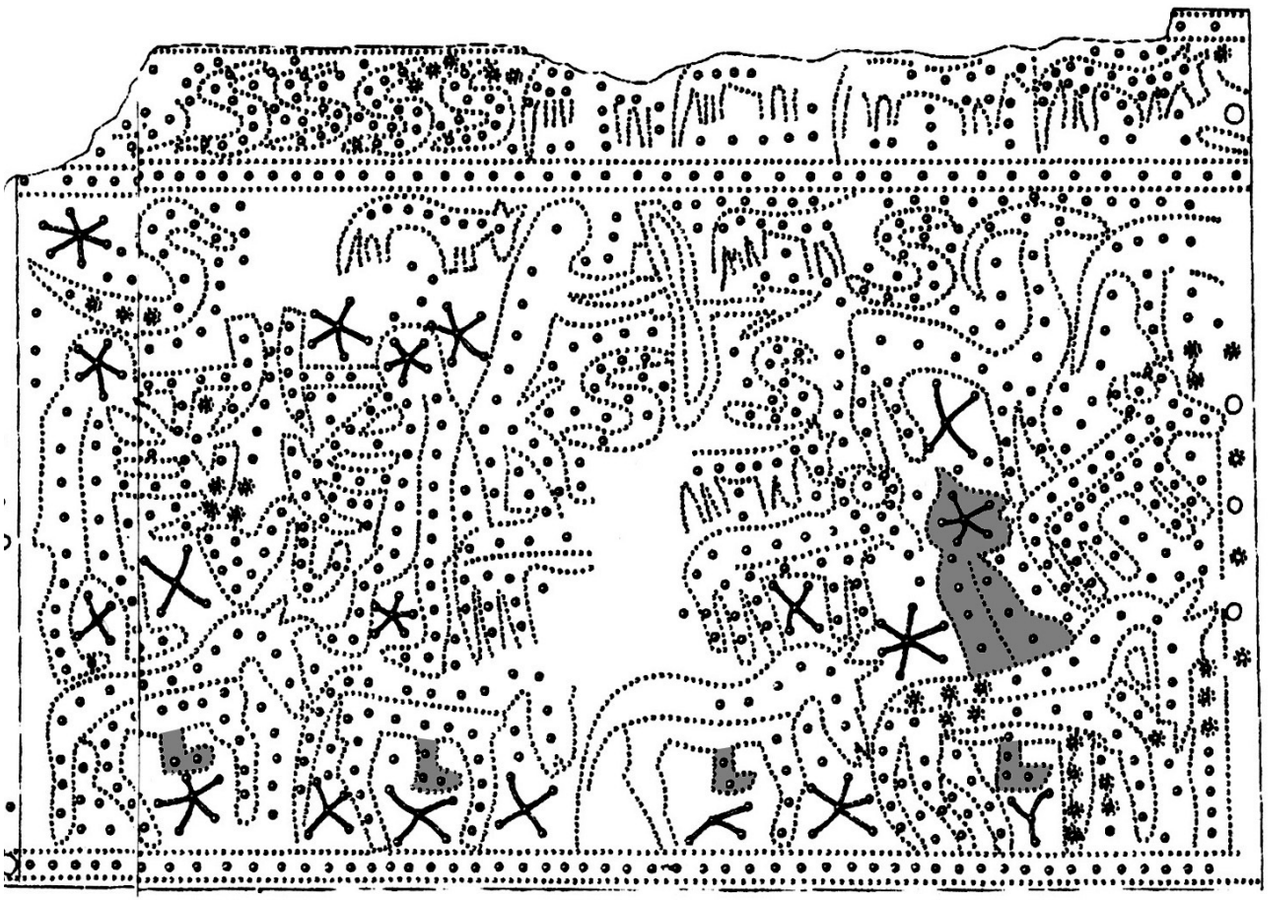

Figure 8. Men on horseback on a bronze vessel from Kleinklein, Styria. After Prüssing 1991, pl. 121.

point of view and described it as subjectivist logic of action, which is common but by no means exclusive to traditional societies (Dux 1982). According to Dux every cause-effect relationship is thought of in terms of an action, with an agent that must be activated for it to take effect. The same manifestation can always be traced back to the same agent. The same agent triggering weight is active in every heavy object, the force of a person who moves the object is the same force as that of other strong people or animals, etc. This action structure of cause and effect means that metapersons are often thought of as human-like and, conversely, that things in which they supposedly unfold their effect are regarded as human-like. This is where the tendency to treat things like people comes from, even in our own society, e.g. when we talk to technical devices (even without Siri) (Strathern 2019, 28; Gell 1998, 18). Accordingly, as Dux notes, «the personification of gods (...) does not depend on their form, it depends on their actions» (Dux 1982, 196). Thus, it is not important what gods look like, but what they do. And of course this also applies to all kinds of metapersons aka metahumans.

In fact, agency is the decisive factor, and it is clearly superior to humans. As a consequence, humans are dependent on metapersons in every respect, i.e. completely heteronomous in their existence (Sahlins 2019: 921). Agents are omnipresent in people's lives, and quite decidedly in this world. Unlike in transcendentalist societies, where everything metahuman is seen as otherworldly, i.e. transcendent, and is thus located in a dualistic system in relation to humans, the lives of people in immanentist societies cannot be separated from those of metapersons. Metapersons are everywhere, in every living being (human, animal, vegetal) and in every object. Metapersons are distributed personages, dividuals as opposed to individuals, and they are present wherever their powers are effective (Sahlins 2019: 936). In some cases, especially in animistic societies, this even means that humans and animals in particular cannot be categorized as distinct from one another as they share the same agents (Descola 2005, 19-57).

It was Descola who has given visual anthropology a very strong impetus, most recently in a book on the forms of the visible (Descola 2021), which is going back in its beginnings to an exhibition in the Musée du quai Branly in Paris (Descola 2010). Turning away from an art-historical approach and forwarding the idea that pictorial works are the expression of ontological beliefs (animistic, totemistic, analogistic, naturalistic), Descola rejects the concept of the image in the conventional sense and speaks of figurations instead. Figurations are visualisations of ideas and agents by pictures. The spoken word should be added to this, in

the sense of the parallelistic properties of words and pictures as emphasised by Carlo Severi (2007). This means that words and pictures complement each other as forms of figuration, for example in ritual acts, something that is, of course, not comprehensible archaeologically.

Descola focusses on pictures, especially on single pictures, omitting pictorial narration by sequential pictures like in situla art. More importantly, he concentrates on pictures only. Yet it is exactly pictorial narration that undeniably demonstrates how objects may work as a medium of figuration in the very same way as pictures do (Huth 2003). The objects shown in situla art do indeed occur as real objects among the grave goods of richly furnished burials of the early Iron Age. This is no coincidence. Situla art is a figuration of a series of rituals and actions which reflect the ontological worldview of the communities making and using them (Huth 2021). These beliefs are the religious basis and legitimation of the order of the world as perceived by them. Religious, economic and political power is rooted in these foundations, and so are status and prestige of the families who set them on stage by sumptuous burial rites. As grave goods, i.e. objects, can be found together with pictorial representations in many burials, it follows that they are not substitutes, but figurations in their own right. Pictures and objects are parallelistic means of figuration, in the same way as pictures and words.

This is also the case for single aspects visualized in situla art and rich burials of the time in general. The aristocratic standing of women, their *aristeia*, closely related to weaving and lavish textiles, is being figurated by weaving scenes in pictorial art, but also by textiles, spindle whorls and weaving looms as grave goods (Huth, Löhlein 2024). The same is true for drinking rituals involving two men and a woman (Huth 2003; 2015) and the figuration of the deceased as a person still commanding its physical integrity by dressing urns with cloths, armour and ornaments (Kohle 2019).

Going back to the Iberian stelae it follows that pictorial representations of warriors and their paraphernalia are figurations of beliefs, featuring persons, artefacts and their agency alike. Metahuman may be a fairly general denotation for the forces standing behind the figuration, yet it is clear that it would be erroneous to regard these stelae as simple and plain depictions of a warrior ideology or as an expression of an elitist way of life based on long-distance exchange and material prosperity resulting from copper mining. If anything, prosperity, status and prestige are an epiphenomenon of the ontological foundations of the communities erecting Iberian stelae, i.e. rooted in a close relationship of the living with the metahumans as the forces behind everything. However, if objects used in religious contexts such as burial rites are equivalent expressions of the same ontological background visualized by pictures, as figurations to be precise, then it is absolutely correct to see burials with weapons and depositions of weapons as a way of figuration, too. This means they are generally comparable with and possibly even related to pictorial representations on stelae or rock surfaces. In this respect Díaz-Guardamino *et al.* (2022) are certainly right, but it would be a mistake to take resemblances of Scandinavian petroglyphs and Iberian stelae at face value.

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CHAPTER 17

Through whose eyes? Profiling the enigmatic Carved Stone Balls of Europe: 'A focus on special Artifacts'

Raphael Ucheh

Abstract

The Archaeological Sciences have enriched our concepts of past cultures and their patterned modes of living which are highlighted through results of various groundbreaking research endeavors and analysis of recovered cultural objects. However, progress eludes the meaningful attempts at understanding prehistoric culture and livelihood, i.e. the material - and sociological well-being of societies, which should otherwise, guide our perspectives through the complex maze of 'place' and 'worldviews' in prehistoric contexts. The elusive 'Carved Stone Ball' (csb) assemblage deserves a place as reference materials for understanding the protracted perspectives of prehistoric cultures, hence, expanding the csb database remains primary for the attainment of that status. An expansion of our notions of the Neolithic and Bronze Age cultures is inherent and calls for re-prioritizing our focus and perspectives of the makers and users of worked stone artifacts of prehistory. This renewed focus takes us beyond appreciating the csb cultural artifacts per se, and into integrating cues vital for our projections of prehistory and for our profiling of cultural objects. To these ends, two subject matters are highlighted, viz: 'Agency' and 'Time-based' contextualities of material appropriation and appreciation. These themes draw our thoughts towards identifying impulse propensities, Affordance(s), and generalized 'worldview synergies', all making inroads to accessing biographies of prehistoric cultures, the ones in which worlds are "made real" (Nilsson Bjorn 1999, 22), with actual livelihoods represented. Bjorn's supposition makes the case for an integration of facts: as observed during everyday interactions, between humans and the semiotically laced meanings and values bestowed through the manipulation of artifacts. The facts which comprise the center stage of interfaces, where realities of purposed living are exchanged, and of which culture is birthed within the ecosystem.

Key words: Carved stones, Meanings, Value, Manipulated objects, Ecological pressures, Cognition, Affordance.

Resumen

Las Ciencias Arqueológicas han enriquecido nuestros conceptos de culturas pasadas y sus modos de vida, que se destacan a través de los resultados de diversos esfuerzos de investigación innovadores y análisis de objetos culturales recuperados. Sin embargo, el progreso elude los intentos significativos de comprender la cultura y los medios de vida prehistóricos, es decir, el bienestar material y sociológico de las sociedades, que de otro modo deberían guiar nuestras perspectivas a través de un complejo laberinto de «lugares» y «visiones del mundo» en contextos prehistóricos. El elusivo conjunto de 'bolas de piedra talladas' (csb) merece un lugar como material de referencia para comprender las perspectivas prolongadas de las culturas prehistóricas, por

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lo que ampliar la base de datos csb sigue siendo primordial para alcanzar ese estatus. Una expansión de nuestras nociones sobre las culturas del Neolítico y la Edad del Bronce es inherente y exige volver a priorizar nuestro enfoque y perspectivas de los creadores y usuarios de artefactos de piedra trabajada. Este enfoque renovado nos lleva más allá de la apreciación de los artefactos culturales de la CSB per se, y nos lleva a integrar claves vitales para nuestras proyecciones de la prehistoria y para nuestra elaboración de perfiles de los objetos culturales. Con estos fines, se destacan dos temas, a saber: las contextualidades de apropiación y apreciación material de "agencia" y "basadas en el tiempo". Estos temas dirigen nuestros pensamientos hacia la identificación de tendencias impulsivas, posibilidades de acceso y 'sinergias de cosmovisión' generalizadas, todo lo cual abre caminos para acceder a biografías de culturas prehistóricas, aquellas en las que los mundos se «hacen reales» (Nilsson Bjorn 1999, 22). con medios de vida reales representados. La suposición de Bjorn defiende una integración de hechos: como se observa durante las interacciones cotidianas, entre los humanos y los significados y valores semióticamente entrelazados otorgados a través de la manipulación de artefactos. Los hechos que constituyen el escenario central de las interfaces, donde se intercambian las realidades de la vida con propósito y cuya cultura nació dentro del ecosistema.

Palabras clave: Piedras talladas, Significados, Valor, Objetos manipulados, Presiones ecológicas, Cognición, ventajas.

Methodology: Coping with inherent data and the realities of information 'curveballs'

The basics of getting to know the csb artifact makers and understanding their views of their world has gained marginal traction through the integration of other scientific fields of enquiry, despite that, challenges integral to the csb database have been highlighted in a hand-full of works of which assertions by Ray *et al.* of the absence of essential "well-rounded ties to social and human dimensions" (1987, 66), sums them all up.

In threading within the contexts of a holistic survey of carved stone artifacts, the Iberian Stelae, just like other worked stone artifact assemblages have maintained a forerunner position during discussions focused on cultural ingenuity, hence, I present bold initiatives undertaken for reinvigorating the csb studies and which are potentially pivotal for broader analysis applications. However, the path to progress is carved deeply through experiences of time-related contexts and Agency, thus, bringing in new character to the world of the carved Stone Balls. Hard as it may sound, the over 500 csb samples without accessible archaeological contexts or reviewable associations, foreshadow our approaches to the csb studies which continue to yearn for tangible and comprehensive updates as recommended for archaeological best practice and provenance.

Carved Stone Ball (csb): Hard Facts

Dorothy Marshall 's catalogue presents the basics for understanding the csb assemblage. Marshall (1979, 64-72), however, a short list of facts about the assemblage are presented below:

• Currently there are a little over 400 recorded samples (Anderson-Whymark, 2019, 43), and exclude those remaining in private hands (more details in: Marshall, 1977, 40-72).

• Aberdeenshire, a hotbed of the csb assemblage with over 220 samples, reflects a remarkable diversity of the phenomena and especially when compared to the Orkadian 'group'. (Anderson-Whymark, 2019, 42-47)

• csb artifacts were probably used and distributed during the late Neolithic, based on their associations within "grooved ware contexts" (Marshall 1979, 61), and up to the early Bronze age. (Anderson-Whymark, 2019, 44; Edmonds 1999, chap. 1)

• Marshall's observed quality and precise workings on some of the artifacts have ignited reflections on Agency and the mindset of the artifact makers. (See Marshall, 1979, 62)

• The csb assemblage's C14 dates based on in-situ finds from the Ness of Brodgar complex, Orkney, are placed at around 2900 BC. (Anderson-Whymark 2019, 44)

• On a brighter side, the Ness of Brodgar Project has recovered other artifacts of shared contexts with the Carved Stone Balls.

These facts highlight the csb assemblage being caught within networks of entanglements of unyielding culture pathways while remaining afloat to various models for reconceptualizing our views of prehistoric Stone-age cultures.

Broadening the search

One path to reconsidering the complexity of the csb corpus leads to establishing comprehensible Biographic profile(s) of the artifact group. While such profiling attempts follow the trails of embedded indicators and streamlined along the intricate notions of "social lives like persons" (Hoskins 1998, 87), and their lived cultural realities, each step

Figure 1: Selection of csb samples (photographs: personal records R. Ucheh).

Figure 2: CSB Distribution Map (after Stewart-Moffitt 2022, Map 5.1.).

bolsters up the links between cultural objects and the perspectives of their creators and bearers.

Object biographies inform us on the dynamic levels of interactions within the precepts of object appreciation and manipulations: their worldview perceptions. And in so doing, exposing some determinants as to what these measures were meant to achieve. The perceptions are not necessarily based on contemporary notions of worth, significance, and durability to the bearers, since time-conspicuous availability, advantageous properties alongside the detailed sequences of procurement and manipulation are to be considered. Some biographical perceptions have been spelt out in the introductory parts to Edmonds and Ferrabys' telling thoughts, in which they note that: "... distinctive greenstone blades had been pulled down from the clouds for more than a thousand years" (Edmonds and Ferraby 2013).

This emphasis on 'Agency-infused' material culture puts up arguments for a connect of worlds, of appreciation and value, where the pull (ability) characteristic of the bearer culture completes the sequences for ascribed significance of objects. These notions identify humans as entities within the mix of material culture and wider-worlds of entities, encapsulating perspectives of life and death, and of the "realms of entities residing overhead" (*ibid.*), and within natural materials, thereby, welding together culture-based perspectives of worldviews within environmental, or Umwelt-related (see below) contexts.

Soft Facts: Agency and Affordance(s)

By idealizing the experiences, rhythms and livelihoods of Neolithic and Bronze age societies, we effortlessly zip ourselves away from 'realities' bounded by salient time-indices and throes of prehistoric life and ecological mechanisms, which molds the causal nexus of human and artifact bonds. These relationships surpass the cognitive intricacies to which patterned behavior, adaptation, perception and creativity are underscored by. These intricacies like creativity, actions etc., as observed within material assemblage should all be integrated into biographic profiling.

The described premise is inclined towards Edmonds' (1999, 137) considerations on material objects of which he asserts as being embodied and ascribed with "value", which were endeared and extended unto daily routines. These views are also echoed by Scarantinos' supposition of the perceivability of "value and meanings" (Scarantino 2003, 953), within given ecosystems, which thus presents us with a fusion of intertwined entities. These views channel our attention to peculiarities associated with value- and meaning-bearing components of our artifact corpus: A fusion of intertwined entities.

The links between late Neolithic and early Bronze Age cultures of north-east Scotland and the Orkney Isles currently stand as convergence points for the carved stone ball occurrence with landscapes of past and present references corroborating with aspects of the Archaeological records. These links pave in-roads to viewing artifacts differently, i.e., as deeply ingrained traces of human engagements on many fronts for 'determined livelihoods and result-oriented

execution of tasks' (Barnatt 1998, 92). Determined living etched in through shared interests and engagements, designated proficiencies alongside technical performances, and generalized cosmic-realities. These engagements are composites which encapsulate perceptions, reactions, intelligent acts with aesthetic inclinations, as well as enhancing necessary interactions within ecologically shared worlds.

Newell and Simon's view of the everyday complexities of livelihoods saddled with the propensity to symbolic interaction "starts with man" (1976, 118). The basic form of behavior characterizing humanness is categorically based on organisms encountering information and how these data are applied, manipulated, processed, and shared within given systems.

Our understanding of humanness prioritizes the projections of dispositional realities of cultures, by deducing cues to Social Memory. Social Memories being realities in their own right, encompass the basic propensities of threats and promises responsible for fostering perception- action couplings by organisms within their direct environments, highlight indices as well as efforts undertaken by groups in orchestrating social (re)negotiations, value renewals and replacements or responses, alongside nuances of selective advantages and the "deployment of considerable forethought" (Ray and Thomas 2018, 295). In aligning with the above projections, the links between Neolithic groups and their predecessors were mediated through metaphors: for understanding, for continuity of practice and for addressing issues of shifting emphasis and meanings, like those of the passage of time, and of their world. (Detailed insights in: Edmonds 1999 and Scarantino 2003)

The inferred realities are focal points for marginal responses presented within the schemes of persistent and alluvial efforts put up in conceptualizing social memory, within which groups intricately renew bonds between their livelihoods, their environments and, what their experiences afford. These perspectives of realities are summed up through Gibson's opinion, that the meanings or value attached to objects and actions consists of what they afford. His view also propagates arguments that affordance(s) integrated into human interaction and action on both social and ecological spheres are complementors to everyday realities. These views position affordance(s) as references of dispositional properties necessary for staying attuned to the "value of (...) what it affords" (Gibson *et al.* 1982, 407) based on direct ecological realities.

Based on Scarantinos' views, Affordances belong to a class of characteristics promoting efficient interactions between organisms and their ecosystems, since they are "response-dependent, (...), instantiated by virtue of a behavioral response a subject would have relative to the property bearer, in suitable circumstances" (2003, 952)

Perspective of realities in these regards comes on the heels of Timothy Johnstons' assessments of the selective costs and benefits of learning through which "organisms live in equilibrium within ecosystems" (1985, 449). Being and staying attuned to time-bound and localized realities highlights the coping mechanisms of cultures, through which the processing of information generated within the human, environment, and material object fusion, i.e.: the selective pressures ensuing into bonds of ecological and chronological frames, are attained.

Scarantino's representation of fusion-derived Affordance is expressed thus:

X (analyzed culture/ material) = possessing Affordance properties (A), at time (t), relative to organism (O). (Scarantino 2003, 956)

This triadic entanglement opens novel perspectives to understanding the relationships between the csb artifacts and their makers within sets of background circumstances (C). These bonds are reflected within Elizabeth Priors' reference to "completer conditions" (1985, 5), with the environment as an entity consummating the bonds. Her reference presents some challenges to prioritizing the scopes of artifact analysis which have sought out models for understanding the bonds between Neolithic cultures and their Mesolithic forebears. Through these bonds, we observe mentalities and cultural ties firmly yoked unto real-time ecological proclivities.

"...affordance predicates are time-indexed incomplete predicates, whose completer is a set of background circumstances..." (Scarantino 2003, 956)

These views of placing societies within contexts of lived realities during specified time frames, are the set-pieces for framing our holistic analysis as they attenuate some of the prevalent challenges of the csb studies. The Potential outcomes to holistic investigations are based on the derivatives of the triadic fusion, to which Scarantino observes that Background circumstances (C), remains 'open' to other circumstances (c) (Scarantino 2003, 957). The rippling effects of these open-ended situations inadvertently result in stressors.

Agency = Affordance + Stressors

Potential stressors as presented here are trends for the adoption of contextual realities emerging from time conditioned propensities. These trends are the drivers of culture which Edmonds identifies to be "mosaics of activities" (1995, 26), which could be traced far into the past and way beyond the timelines and ecological mechanisms of our

focus. These processes and mechanisms are pivotal for understanding the outcomes of marginal response by prehistoric groups within dynamic contexts and time settings.

Edmonds' considerations on the realities of "values" (1999, 16) are subjectified through a groups' consistencies within cultural environments. In this sense, value is embodied by the ideas and concepts of maintenance and management as entrenched within groups experiencing the rhythmical throes of their ecosystem. Such enduring commitments as those undertaken during the transformation phases between Mesolithic groups and their early Neolithic counterparts at about 4000 BC to 1900 BC resulted in the control and sustenance of rhythmic adjustments to ecological trends, and these came alongside (re)negotiations of values and attitudes, which would eventually deliver gains and losses. The observed results of their actions, furthermore, traces pathways for understanding fourth millennium BC. cultures as spelt out in Barnatt's thoughts. (1998, 92-105)

The gains and losses are prerequisite processes which resonate with experiences and adjustments to livelihoods of prehistoric cultures. These everyday processes like access to resources, their bounds of kinship ties, their mentalities, comfort recluses and niches, all influenced their negotiations for staying in harmony with their environments while positively navigating through the lattices of their time-based ecological perspectives. The effort to integrate the concepts of affordance into our understanding of rock art and prehistoric stone carvings is underscored by Scarantinos' proposal for a process for investigating the "reliable abilities such that the probability of success (when) given a try is not only positive but also significant" (Scarantino 2003, 959). The listed processes place prehistoric environments beyond the obscured backdrop for narratives, since they present lived-in ecosystems as "artifacts of history" (Edmonds 1999, 4).

A synergy of purpose

Highlighting these frameworks for understanding Affordances shapes our perspectives of cultural objects, on material manipulation, and on the wide-reaching notions it suffices, therefore, making it relevant for analyzing Prehistoric culture.

Affordance being the unconscious resort during interactions between organisms and their direct ecosystems is firmly anchored on the neurobiological account for human behavior, within stipulated settings and "environmental impacts" (Sarto-Jackson *et al.* 2017, 735). Our views and perspectives of prehistoric culture, furthermore, unites human societies, surface disturbances, and all activities, caught within the cross-hairs of fluxed synergies of actual experiences and realities, since culture must be viewed as integral to the environment.

Actual realities comprising of a paradigmatic 'triadic' fusion, brings to fore Sahlin's view of a cosmic polity of "Metapersons" (Graeber and Sahlins 2017, 20), in which people, their notions, their perceptions of their direct ecosystems and the marginal responses there-of, are bound within a constant network of encounters. These cyclic constants of lived-realities within contemporary settings are generators of unpredictable degrees of outcomes. In Scarantino's opinion stated above, the by-products of fusions are "response-dependent" (Scarantino 2003, 953), of which in human societies I would describe as generating stressors.

It is equally right to concede at this point that human attempts at managing the rhythmic cross-roads between individual and group-realities, between entities, at specific situations, would inadvertently be conditioned to stressors. In the same vein, for the attainment of the well needed accords between entities, cultures rely on quivers of "capital" (Edmonds 1999, 144) essential for negotiations through the maze of realities. Affordance(s) make up the negotiatory input for holding open the channels essential for proceedings through and between 'Worlds'.

To conclude the first aspect of this profiling endeavor, I present Agency as an integral aspect of the triadic entanglement, and which is naturally saddled with generated stress, the essential proceeds accrued through interactions whose proceeds are responsible for the human ability to shape and Build-up worldviews (Ingold 1986). The dynamics of dealing with stress-factors and generators were the focus of Gibsons' arguments on how organisms perceive their worlds (2014). Furthermore, his perspectives take us beyond the concepts of what the environment offers or furnishes the organism with, unto the considerations of the arbitrational basics between worlds of 'realities' which are to be viewed as the "stretched out persistent transformation focus of lived lives" (See Edmonds 1999, 5), which are deduced from volumes of observations and references to changes and alterations within cultural assemblages.

The 'Umwelt': An Entity?

Cross-entity interaction has been a long-standing norm occurring before the chronological focus of our discussions. In John Barnatts' thoughts on monuments and archaeological remains, his ideas relating to the intricate bonds between cultures and the observed siting of monuments or their visibility to the world are shared. In his view, these were not the only driven factors to the phenomenon (Barnatt 1998, 92-105). He has, like many other analysts, maintained that the complexities for clear-cut observations are enshrined

within a world of topographies charged with the recalcitrant and enduring givings and misgivings of ecosystems which shape Worldviews. All of which infused socio-cultural ties, norms, and bonds and thus making up a holistic 'Entity', an Umwelt, a matrix of contact points.

Available evidence corroborating several episodes of conscious or circumstantial environmental alterations during earlier prehistory are the foundations for these interactions. However, the impacts of these alterations became intensified from the "Middle neolithic and onwards as derived information indicates that the onset of sedentary traditions by human groups may have been a potent contributung factor. (Roymans and Gerritsen 2002, 264)

Ecological evidence relating to the Prehistoric regions of Northern Scotland are sparse and due to the exactness of ^{14}C readings, may be slightly imprecise (more details in Pilcher 1991, 28-33). However, they highlight relevant points of intrigue. Furthermore, the climate evidence from the Holocene records, although widespread, are seemingly complex for straight-lined and direct solutions to our assessments of transformation patterns. These data remain contestable, (see Seppä *et al.* 2005), however, the Holocene Thermal Maximum (HTM) records (Renssen *et al.* 2009) for peak developmental phases for Pines across northern Europe are mainly characterized by temperature increments of about 2–3°C above normal between 6850 and 2450 BCE (8000-4400 cal. BP) (Edvardsson *et al.* 2016, 130). These indicators provide some foothold for drawing holistic profiles of prehistoric ecosystems by pointing out trends of regional realities, to which human cultures and other species would have related to. Therefore, investigations bordering on the role of the Umwelt within the 'triadic' fusion places us on a better path to knowledge of prehistoric cultures and their worked stone materials.

For this profiling attempt, our focus rests on stacked up Proxy-records derived from surface and bog pollen sediments, and the relations between *pinus* species found within peatland bogs. These data inches us closer o better our understanding of later Holocene conditions and activities which extended to the later Neolithic phases within our focus region.

Broad sampling and calibrations from the far North of Scotland highlight revealing conditions relating to pollen information from 4255 ± 60 years B.P. (Gear and Huntley 1991, 543, Fig. 3.), which are based on cross-referenced geographic spreads which affirm widespread convergence of ecological realities for enriching our proxy-data backdrop.

To bolster-up the proxy records, other ecological trends have been considered for assessments of the ondition of the pinus samples on recovery and how they relate to the bogs they are preserved within. Incidences of adventitious-root developments observed on sampled trunks of *pinus* species point to phenomenal markers coinciding with phases of elevated water-table within the studied areas, with reduced aerated bog conditions resulting in the development of "adventitious structures" (Moir *et al.* 2010, 5). Further findings also show incidents of reduced ring-width of pine trunks growing within peat bogs. The conditions characterized by measurements of < 0.50 mm/yr indicate extreme survival conditions within elevated hydrologic states which are detrimental to the species survival. The analyzed rings showed anomalies in their development of concurrent narrowed rings width and points to the overall growth- and survival trajectories of the species. The results obtained using (x20) Stereo-microscope calibrated to =0.01 accuracy levels, reflect High Mean Sensitivity Values (MSV) indices for species well-being and decline timelines during intense climatic mechanisms. With such deduced conditions indicating stress actuators inductive to the species and spread across the general ecosystem.

Reflected climatic abnormalities between 3000-2990 BC; 2960-2950 BC, and 2910-2900 BC. (Moir *et al.* 2010, 8) which characterize trigger phases also match-up with results from other studied sites (Leuschner *et al.* 2007). The noted abnormalities expedited the development and spread of peat from 2800-2790 BC, 2750-2740 BC, and 2700-2680 BC. (Lageard *et. al.* 1999), and were also responsible for a southward spread across Northwest England.

Synchronous decline in Scottish *pinus* populations at about 2500 BC (4450 BP) (Gear and Huntley 1991), reflecting regionalized species upsets aligned with calibrations of 2569 BC from Garry Bog (Boswijk and Whitehouse 2002). From Scandinavia, similar observations from Sweden have been made (Edvardsson *et al.* 2014). While records from mainland Europe reveal that dying-off phases of Scots pine species occurred at about 2960 BC, 2880–2870 BC, and 2780-2730 BC. (Leuschener *et al.* 2002) respectively in Campermoor, Germany. These noted conditions potentially ushered in phases of dynamic ecological uncertainties. Furthermore, similar phenomena with chronological convergence have been observed from the Netherlands (Leuschner *et al.* 2002), and Finland (Helama *et al.* 2004). The scale of data-catchment and chronological inferences emphasize a transregional phenomenon of which the impacts on prehistoric human societies have been largely ignored (Boswijk and Whitehouse 2002; Lageard *et al.* 1999).

Rapid rates of alternations in ecological conditions underscore dying-off phases between 3250-2250 BC (5200-4200 cal. BP) (Roland *et al.* 2015; 2014), therefore indicate turning points for ecosystems within the data catchment areas and beyond. The sampling methodologies resonate with reliable data assemblages aimed at buttress-

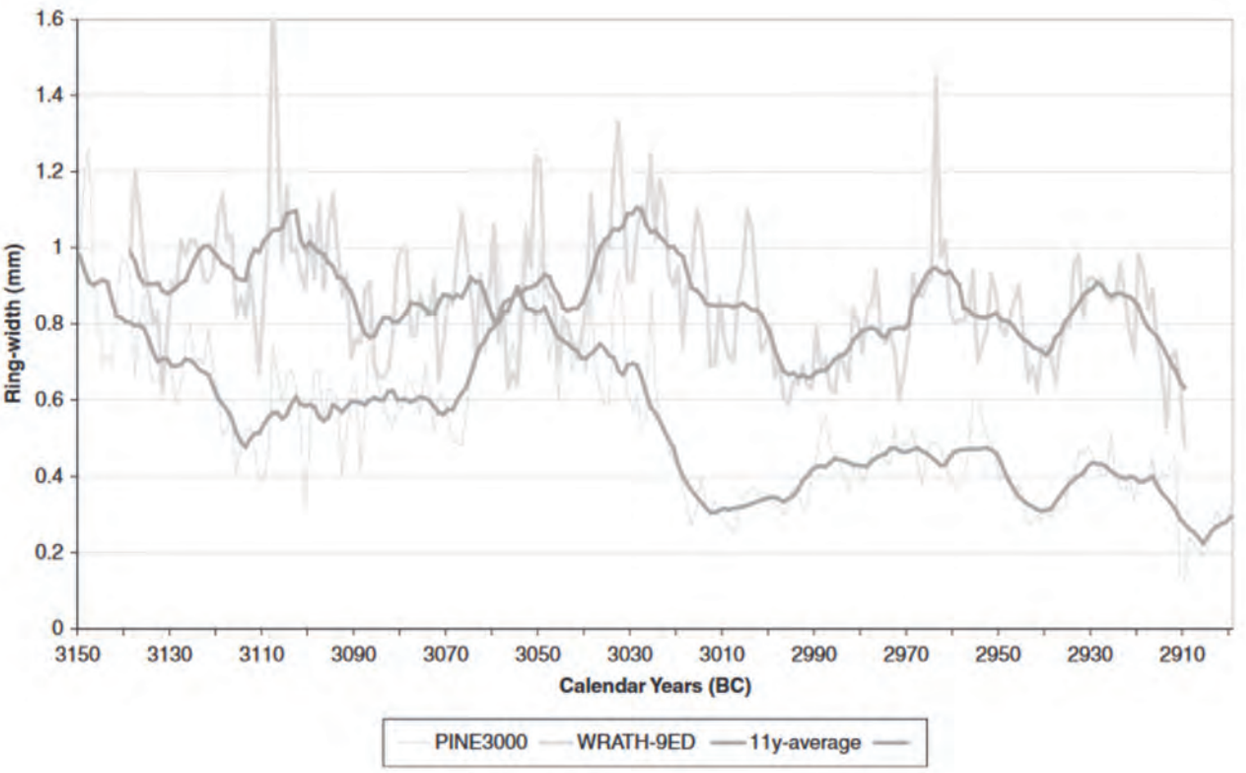

Figure 3: Ring-width plot of sequences WRATH-9ED (upper) and PINE3000 edited to span 3150–2900 BC (lower), which cross-match together with a t-value of 5.7. Similarities in the patterns of variation at both high and medium frequencies can be seen (after Moir et al. 2010, 10, Figure 5).

ing the available palynological records. Furthermore, the indicators of pine species' wellbeing within peat bogs generated from the WRATH-9ED for 3139-2910 BC., increases the potential for investigating their responses to regional ecological watersheds (Moir *et al.* 2010).

Agency relations

The highlighted conditions specifically focusing on ecological response to alternating conditions direct our understanding of the remote relationships this information infers with our knowledge of other species populations within our focus catchment ecosystems.

Although the assembled data provides difficult to decode ecological signaling for the evaluation of anthropogenic response, findings from Digg, northern Trotternish, Skye strongly indicate human interference on, or manipulations to woodland populations. These signals are indicated through increases in shrub pollen and micro-charcoal between 8350-6850 BP, and coinciding with dryer conditions (Selby *et al.* 2023). These same climatic trends responsible for improved marine and hydrological conditions also led to enhanced vegetation disturbances along retracting coastlines after 6498-6716 cal. BP (5808 +-36 cal. BC) (Selby and Smith 2016). Other trans-regional indicators mirroring anthropogenic trends feature decrease in arboreal pollen, which is attributed to regional clearance from ca. 5078 cal. BP (Selby *et al.* 2023); reduced micro-charcoal levels which indicates targeted woodland exploitation and indelible alteration of ecological balance. Furthermore, trends such as: growth-inhibiting phases of pinus species, marked by shortened surface-drying of bogs coincide with the prevalent spread of peat along continental fringe-regions and thus supports the notion of heavily burdened ecological realities shortly after 3000 Cal. BC. (Mighall *et.al.* 2004).

An overview of ecological realities:

– Lower horizons of Pine growth in southerly regions infer with widespread occurrences during the Holocene.
– ^{14}C dates for Bimodal peak of pine occurrences highlight major wet phases: ca. 5200-4700 cal. BC and 2900-2350 cal. BC. (Mighall *et al.* 2004)
– Frequent floods are corroborated by 506 ^{14}C dated fluvial units from Britain (Mackenzie *et al.* 2005)
– Mineral growth of pinus within bogs, an aftermath of altered climate rhythms, commenced at about 2840 and 2500 cal. BC respectively.
– Indications of regional regenerative response of Pine after climatic upsets are linked to phases of lowered water tables (Moir *et al.* 2010).
– Radiocarbon dates indicate broader phenomena during the Holocene, with varied reactions to climate switches depending on bog type. These variations observed from the

pine / peatland relationships are tied to the effects of precipitation and Evaporation rates on topography.

The identified instances of prolonged bog wetness, well into ca. 2000 cal. BC. are characteristic to the north and south of Scotland and are in contrast with situations of the rest of prehistoric Britain, while the attained ^{14}C dates indicate extensions of the phenomena from the Holocene, with variations in the species reactions to climate switches.

Discussion: A Synthesis for solutions

The need for alternative perspective-streams and data sources presenting new insights into the sense behind the csb's, calls for a flexibility in reasoning coupled with interdisciplinary approaches for confronting the series of challenges presented within the realms of analyzing artifact groups. With new evidence of ecological trends, one is drawn in to enquire if the Neolithic and Bronze Age societies learned from experiences in forging out solutions. This question is presented in viewing the phenomenon of carved stone art and artifacts like the Iberean Stellae. With recent experiments carried out which aim at ascertaining the applied tools and technological knowhow for achieving the results observed, we are drawn to reconsider in holistic terms, the states of mind of the culture bearers. This brings us furthermore, to enquire on what indices from the meta-data, i.e., successes, actions/reactions, or pitfalls, could be at play.

The list of queries goes on and on, however, we may have to focus mainly on the kinds of stressors prehistoric societies would have had to deal with, from various approaches.

In buttressing the links between human societies and material culture, I spell out cues of correlations which abound for establishing relationships which are strictly based on patternings played within historiographical substance and cultural contexts. Through these cues the dynamics of humanness within the strong bonds of entities are evaluated.

This stream of reasoning resonates with the numerous investigations into space and territoriality, norms of possession, cognition, and considerations on ascribed value governing material appropriation and manipulation. This resonance is extended into specializations, and affordance, where social and physical capabilities, as well as the human cognitive processes, are co-opted into our understanding of perception, communication, behavior, and imprinting.

The dearth of Paleoclimatic information for the Iberian Peninsula may hold back pivotal answers beyond the reach of current analysis, however, reevaluations of artifact assemblages and excavation reviews have produced relational indicators to technological harnessing of carbonized steel: a process mainly attained through the intensive dependence on greenwood/ forest resources, which as yet, is proven to be the most viable material for prehistoric stone working in Iberia. This repositions our perspectives of past cultures and their worldviews (cf. Araque Gonzalez *et al.* 2023).

Archaeology's links to the cognitive sciences are hereby intensified and frequently applied for the identifying and analyzing of basic processes and codes for explaining culture and represented as material evidence. These codes are open to be integrated into our perspectives of events and settings associated with focus groups and phenomena. While agency analysis presents how patterned culture and codes have been conductors for embracing 'Worlds'. While Agency analysis presents to this analysis some patterned traditions and codes which are conductors for embracing cosmologies, the worlds of perceptions teeming-up with divergent realities and perspectives remain distanciated from the 21st. century analyst whose attempts at making sense of prehistoric objects while also coming to terms with realities and socialization-cues of the past.

Agency-input, structure-formation, intuition, decision-analysis and systemic-organization are all codes and traits characteristic to being human. The code-listings are endless, however, these codes play triggering roles which intricately steer the pathways for interaction, adaptation, and survival. These pathways trudged on through this analysis model enables in-depth assessments of Biographies: of material culture and of societies through the hallways of time, in which avenues of attached material metaphors are appraised.

While incorporating these concepts and appraisals into our perspectives of past cultures we observe the dynamism of multi-leveled and weaved-through relationships within the concepts: of humanness, the 'Umwelt' and all its misgivings, together with the non-categorical spheres viz. perspectives, affordance(s), and motor-processes which enhance actions and are acknowledged through material culture. By integrating the concept of fusing together Agency, the Environment and Material culture into the Iberian stelae analysis, the known dynamics of technology are challenged through the experimental attainment of carbon steel tools, made to probably equal characteristics with the chisel sample from Rocha do Vigio. The forging process for attaining hardened steel tools would be saddled with far reaching ecological imprints, whose dynamism remain elusive to the archaeological data spectrum, and furthermore, creates new avenues for understanding the perspectives of prehistoric cultures.

In embracing this dynamism, our assembled data indicates a variety of 'Constants': i.e. Stressors interwoven all through the 'triadic-fusion'; Stressors generating impulses and grounds for action; Stressors engendered through and during re-negotiation of bonds; Stressors as-

similated into gestures and concessions for everyday livelihood (Jones and Diaz-Guardamino 2019).

Finally, the constants highlighted in these discussions must not only be relegated to perspectives of prehistoric worldviews, since our perspectives of contemporary 'Worldviews' are nonetheless checkered through time and context-based alterations.

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The western Iberian stelae from the Final Bronze Age and Early Iron Age transition (c. 1200-550 BC) are rock art monuments that superbly represent the complex triangular relationship between culture, technology and communication. This book presents contributions from a multidisciplinary team of researchers and craftspeople to the comprehensive investigation of these monuments within their cultural and chronological contexts. The approaches encompass geo-archaeology, petrology, experimental archaeology, landscape archaeology and visual culture studies. Moreover, the technologies of prehistoric stone working and possible tools used for stelae making are examined by archaeometallurgical analyses, experimental replications, and traceology.

This combined methodology goes beyond the traditional study of the motifs and their compositions on the stelae, seeking to re-evaluate the rock supports and the reasons for their choice, explore the technologies used for their production, and discover the symbolic significance of these stelae for the communities who created them. Eventually, this research considers the perspectives of stonemasonry, bronze and iron metallurgy, and technology transfer. This has resulted in new insights on the social and cultural implications of the Western Iberian stelae, the emergence of early Iberian iron metallurgy, technology transfer, innovation, and intercultural contacts between the Mediterranean and the Atlantic at the dawn of history.

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